ERS Field Report 23

SUGGESTED PROJECT DESIGN
SENEGALESE COMPONENT OF THE OMVS REGIONAL GRAIN STABILIZATION PROJECT

William E. Garvey
Gordon Shields
George Enfield

U.S. Department of Agriculture
cooperating with U.S. Agency for International Development
September 1972

CONTENTS

SUGGESTED PROJECT DESIGN

SENEGALESE COMPONENT OF THE OMVS REGIONAL GRAIN STABILIZATION PROJECT

INTRODUCTORY NOTE

The Senegalese component of U. S. Agency for International Development (USAID) assistance to the OMVS [1/] Regional Grain Stabilization Project is authorized under Non-Capital Project Paper, Project No. 625-11-150-600, April 2, 1972, and revised March 1972. The long run objective of this project is to involve the countries of Mali, Mauritania, and Senegal (members of the OMVS) in a regional program to manage cereal grain supplies. The project authorizes technical assistance and other funding inputs for an initial effort (FY 72-FY 75) to develop relevant and complementary domestic cereal grain supply management programs in each OMVS member country as a basis for initiating effective regional cooperation.

The following discussions represent this team's suggested design for the Senegalese component of the OMVS Regional Grain Stabilization Program. It is intended as a working document, and the team anticipates there will be a number of additional inputs into the design before it becomes final.

In preparing its report the team has followed guidelines provided by USAID and the Malian project design, which was suggested as an example.

PROJECT SETTING AND RATIONALE

Two USAID contract studies have been completed concerning the feasibility of developing a regional grain stabilization project. These studies are:

1. A Study and Plan for Regional Grain Stabilization in West Africa, Contract No. AID/csd-1588, Food and Feed Grain Institute, Kansas State University, Report No. 21, December 1970.

2. Food Grain Production and Marketing in West Africa, Contract No. AID/Afr-664, Checchi and Company, Washington, D.C., Final Report of a Special Study Team, March 3, 1970.

1/ Organization for Development of the Sengal River Valley (OMVS) was created March 11, 1972 as a successor to the Organization of Senegal River States (OERS).

Both studies conclude that a regional program to manage cereal grain supplies in the OMVS states is feasible and necessary providing individual country programs develop the required infrastructure, market policy, and management mechanisms.

Several studies of the same subject by other organizations have reached the same conclusion. Those which the study team have found most useful include:

1. Markets and Marketing Methods for Local Cereals (Millet, Sorghum and Corn) in Senegal, in the Light of SODEVA Projects, A Summary of the Analysis of Medium Term Markets for Local Cereals in Senegal, and Proposals for a Rational Marketing System. R. Mangolini, 27 August 1971. The Society for Agricultural Extension and Development, Dakar.

2. Economic Aspects of the Problems of Food Crop Production. R. di Furia, Institute of Food Technology, FAO Technical Report 1, 1970, Dakar.

These reports are now in AID-Dakar library; consequently, regional and country background data will not be reported in this project design.

MARKETING ELEMENTS MISSING

Senegal lacks, at this time, certain marketing elements required to establish a grain supply management program. These missing elements include:

1. An adequate structured organization within ONCAD [2/] (the official marketing agency) managerially and technically capable of operating an expanded and effective program.

2. Adequate grain storage facilities.

3. A well developed and coordinated grain production and marketing policy.

4. An adequate procurement system at the farm level.

5. Trained managerial and technical cadre.

In addition, existing price policies for both purchase and sale of cereal grains are such that they restrict the opportunity

---

[2/] Office National de Cooperation et d 'Assistance pour le Develment.

to develop market outlets for millet and sorghum; yet, at the same time, in most cases, they do not cover ONCAD operating costs.

The cereal grain production program is impressive. Scientific and material resources are being devoted to increasing sorghum and millet production. Production research and field testing is carried out by IRAT.[3/] Extension work as conducted by the Agricultural Service and, in the peanut basin, by SODEVA [4/] is leading to substantial increases in sorghum and millet production.

Initial program emphasis will be placed on aiding the Senegalese Government to develop its grain marketing infrastructure and to strengthen the managerial and policy making capabilities of its operating agencies. A program of assistance in the production area is considered subordinate in priority to the marketing sector.

The production goal established by the Government of Senegal (GOS) in its most recent development plan is 700,000 tons of millet and sorghum in 1972. Official estimates of the 1971 crop (a normal rainfall year) show 600,000 tons, and production may have been as high as 650,000 tons. In drought years during the past decade, however, production has dropped to as low as 350,000 tons. Yields per hectare are gradually increasing and SODEVA agents are confident that, given normal rainfall, production will reach 800,000 tons in the next few years. Within the peanut basin SODEVA estimates cereal production will increase by 80,000 MT within the next 5 years.

Briefly, by region, the situation is as follows:

Diourbel - Generally a deficit region in cereal grains, with probably the widest fluctuations in cereals available for consumption between normal years and drought years. Within the peanut production area and subject to very heavy population pressure on the land.

Thies - Similarly a cereal deficient area within the peanut production area, although production varies less widely from year to year than in the Diourbel area.

Sine-Saloum - The third region within the peanut basin and, except for the area bordering on The Gambia, deficient in millet and sorghum even in normal years at present rates of production.

Casamance - Not a heavy sorghum/millet producing area, but not deficient in cereal crops, given the substantial production of rice, corn, and other food crops in the region.

3/ Institut de Recherche Agronomigues Tropicales.
4/ Societe de Development et de Vulgarisation Agricole.

Fleurve - A region deficient in rainfall. Yields are smaller per hectare than other regions but it is capable of producing sorghum in the river beds as flood waters retire. Food deficits tend also to be made up by rice, which is produced in the valley.

Senegal-Oriental - A surplus production area for sorghum and millet but far removed from areas of consumption.

In addition to millet and sorghum, Senegal produces approximately 120,000 tons of rice per year and 50,000 tons of corn. Considerable emphasis is being placed on increasing production of both crops and potential is considered high, particularly in the Casamance.

Imports of rice are currently running above 200,000 tons per year, corn about 15,000 tons, and net imports of wheat about 75,000 tons.

In summary, sorghum and millet are the basic food grains of the country. Production is lagging somewhat behind potential consumption but will, within a few years, assuming normal rainfall and continued successful development efforts, be sufficient to cover consumption requirements. Unfortunately one can expect abnormal rainfall years with some frequency, and this results in a substantial food grain deficit. In addition, several areas suffer a production deficit even in normal years, and surplus areas are far removed with high transportation costs.

Rice has become very popular with the urban population because of its ease of preparation, its favorable price (cheaper than millet in Dakar, for example), and its taste. Ironically, the national dish of Senegal is fish with rice (the rice imported from Cambodia) rather than cous-cous.

Traditionally, the Senegalese peasant produced sufficient millet or sorghum for the consumption needs of his family and stored his grain on the head in farm granaries made of banco, branches, or straw. Millet and sorghum stores very well in this manner and some ethnic groups such as the Serrere and the Sero-kolé maintain the tradition of storing their grain in this fashion for 2, 3, or more years.

As peanut culture was introduced during the colonial period, cereal production decreased. Furthermore, as the peasant entered a money economy and consumer goods were introduced, he felt a need for cash to satisfy family needs for sugar, tea, cloth, and other small items. This cash he often obtained during the year by selling small quantities of grain. In this manner evolved "the soudure," the period of food shortage, often extreme, just before the harvest, at a time of heavy food requirements by the peasant and his family. To satisfy these food needs the peasant must buy grain at inflated prices, or barter against his coming harvest at extremely low prices.

The farmer selling his future crop in this manner may receive from 8 to 10 CFA per kilo. At harvest time through December the selling price varies from 10 CFA to 17 CFA in a normal year, and from 18 to 22 CFA in a drought year. Through spring and summer, price rises to 25 CFA on the farm and 35 CFA in city markets in a normal year, but following drought years will often go up to 45 CFA. During periods of serious shortage, prices may reach 50 to 60 CFA per kilo when grain is available on the market.

The official price structure is somewhat different, with farmer price at present set by ONCAD at 17 CFA per kilo throughout the country and throughout the year. Resale price by ONCAD to farmers during the soudure period is 23.75 CFA per kilo. The semi-wholesale ONCAD price is 29.75 CFA/kilo, and the retail price is 31.50 CFA per kilo. These decreed prices are theoretically supported by a grain stabilization program of the official marketing agency, ONCAD, through a system of sorghum and millet purchase, storage, and resale. However, for a number of reasons, purchases have never exceeded 27,000 tons, have usually averaged from 1 to 3 percent of the total crop, and have dropped in recent years nearly to zero. Estimates of the quantity of sorghum and millet reaching the market annually vary from 25,000 tons to as high as 300,000 tons, or almost half the crop. The project design team feels that the present level of commercialization is between 100,000 and 200,000 tons. As production increases, a substantially larger proportion of the increased production will seek a market.

The Government of Senegal has declared a policy to redistribute surplus millet and sorghum from regions of excess production to deficit areas, to ameliorate the speculative prices resulting from scarcity, and to maintain a reserve supply in case of serious scarcity. These objectives have not been achieved since ONCAD, the official marketing agency, for a number of reasons, but most obviously a lack of resources, has not put the policy into effect.

ONCAD's major responsibility continues to be to market the peanut crop, and its structure is designed and its resources channelled almost entirely to achieve that objective. ONCAD has no storage facilities available for or suited to cereal storage. It has suffered heavy damage to much of the grain it has attempted to commercialize in the past due to this lack of facilities and the lack of a cadre technically capable of storing and caring for it. It has not had sufficient funds to commercialize a substantial proportion of the crop, despite the fact that it was, until recently, in theory at least, the only legal buyer. In addition, its buying structure in the countryside has not been adequate for any substantial grain commercialization.

Grain purchases have been handled either by cooperatives or by ONCAD "seccos" (peanut seed storage facilities). While there is a generally excellent geographic distribution of these organizations and facilities in the countryside, particularly in the peanut basin,

they are not up to the task. The cooperatives do not function as true cooperatives, but largely as a peanut marketing channel. They are usually too small to have a permanent weighmaster, and they usually have no storage facilities. The storage at seccos is preempted by seed storage during most of the year, as is the time of the secco manager during grain harvest time. Probably of equal importance is ONCAD's inability to get on the market at an early date and to offer as easy or as flexible terms to farmers as commercial dealers can offer.

As a consequence, ONCAD has almost ceased buying local millet and sorghum during recent years, although it continues to distribute foreign donated grain to the best of its ability.

ONCAD has not attempted to exercise a monopoly in grain marketing but, in recent years, has moved to licensing commercial dealers. Dealers are constrained to buy and sell at official prices, to report the volume of their trade, and to seek authorization from local authorities for shipping large quantities of grain. Most authorities consulted by the team felt these regulations were largely ignored.

A schedule of official prices is published by ONCAD before each harvest. As mentioned earlier, the farmer buying price for the last season was 17 CFA per kilo, while at semi-wholesale it was set at 29.750, and at retail at 31.500 CFA/kilo. However, the farmer resale price -- and apparently most of ONCAD's purchases are resold to the peasant during the soudure period -- was set at 23.750. Since ONCAD's published marketing costs amount to 11.745 CFA/kilo, their marketing loss on grain resold to the farmer was nearly 5 CFA per kilo. Given the substantial losses suffered due to lack of adequate storage and inadequate damage control, their operating losses were even higher and give some clue as to ONCAD's faint enthusiasm for grain commercialization.

The official price of 17 CFA to the farmer is high compared to the present world market price of 12 CFA per kilo. It has been established and maintained at this level or even higher since 1965 in an effort to encourage greater production. This price has undoubtedly been a factor in the steady increase already noted. It will be interesting to note the effect on millet production of a recent increase of the peanut price to 23 CFA/kilo. This advance makes the average net return per hectare from peanuts considerably higher than from either millet or sorghum. Extension agents in the field do not feel the success of their millet campaign will be dampened by this change in relative prices and believe, in fact, sorghum prices could drop as low as 12 CFA per kilo before affecting production. They cite as reasons:

1. The higher responsiveness of millet and sorghum to improved and increased input compared to peanuts, giving higher marginal returns, even at disparate price ratios.

2. The need to produce sorghum and millet for home consumption.

3. The need to maintain a crop rotation, particularly in the heavily cultivated peanut basin.

4. The 23 CFA peanut price probably cannot be sustained, and will drop in future years.

While the 17 CFA sorghum price has helped push grain production, serious consideration must be given to the undesirable effects of this price level, particularly since it does not appear essential to boosting grain production. The most undesirable effect is that it places the consumer price of millet and sorghum at a level nearly equal to that of rice. This encourages the consumption of rice, most of which must be imported for hard currency. Furthermore, such a high farm-level price makes feeding sorghum and millet to livestock uneconomical. This is doubly unfortunate. The commercial development of the potentially important Senegalese livestock industry requires a source of feed grain, and the quantities of millet and sorghum Senegal plans to produce will need additional markets other than human consumption within a very few years.

In addition to its efforts to increase sorghum and millet production and to stabilize cereal marketing through a purchase and storage program, the Government of Senegal has attempted to encourage the formation of reserve village granaries, to be stocked out of donated villager resources. These granaries are to be two types, one for village consumption during the soudure, the other as a reserve in time of famine. The government program as such has consisted entirely of decree and exhortation, and as far as the design team was able to discover, has been completely unsuccessful. Most authorities consulted felt that such a storage program at the village level would inevitably fail since it did not conform to the pattern of Senegalese customs, but that a program encouraging greater on-the-farm storage is feasible.

The relative effectiveness of the grain marketing system might be summarized as follows:

1. Somewhere between 100,000 and 200,000 tons of the normal Senegalese sorghum-millet production of approximately 650,000 tons is marketed.

2. A substantial quantity of this grain is bought back, often at much higher prices, by the farmers who produced it.

3. Most of this trade is conducted by illegal dealers, often on credit at prices substantially below the official price level.

4. In times of shortage, as for example when production drops by 100,000 to 200,000 tons during the drought year, prices increase spectacularly above official price levels, especially during the soudure period.

5. For all practical purposes there are no public or private storage facilities in existence other than on-the-farm granaries to permit a substantial carry-over from surplus to deficient years.

6. The Government of Senegal has a reasonably well developed policy for improving the marketing situation and a reasonably capable organization (ONCAD) for implementing it.

7. ONCAD's activities under this program are ineffective for the following reasons:

   - the organization, resources, and talent are pre-occupied with marketing the peanut crop and with the consolidation with OCAS, the former rice imports and distribution organization.

   - ONCAD lacks financial resources to handle a substantial percentage of the crop.

   - ONCAD lacks adequate grain storage facilities.

   - ONCAD's grain commercialization structure and cadre are inadequate to the task.

   - ONCAD's potential buying points (co-ops) are not adequately organized, trained, or equipped to handle the task.

   - Senegal lacks a crop reporting system adequate to enable the planning and execution of a stabilization program.

   - ONCAD's cadre requires additional technical training in grain handling methods, insect and other damage control, etc.

Millet and sorghum production in Senegal has been increasing in recent years. Much of this increase can be attributed to the introduction of improved inputs, including heavier fertilization and improved seed varieties. Animal traction, particularly using oxen, has been an important factor. Present production goals are to reach 800,000 tons over the next 3 years. Given normal rainfall years it is possible that Senegal may attain this goal.

The average rainfall in the major grain producing areas outside the northern one-third of the country appears to be sufficient to meet crop needs. Wide fluctuation in both the amount of rainfall and its distribution from year to year present the major difficulty. Farmers are industrious and hard-working, with a keen capacity to analyze opportunities open to them.

The more apparent grain production problems are:

1. The cut and burn system of land-clearing results in fields overrun with sprouting tree stumps. These reduce the water available for cultivated crops and interfere with land preparation and weed control.

2. A heavy weed infestation, mostly grasses, at planting season when demands on farm labor are high.

3. A shortage of well trained heavy draft animals. Animals are often in poor flesh and are not fed grain even during the peak work season.

4. Soils are low in natural fertility and organic matter and somewhat acidic, with a pH of 5.8 or less. Texture is sandy with a low salt content, and the clay content, usually kaolinite, runs between 4 and 20 percent.

5. Fertilizer production and use is low and somewhat irrational. Of the estimated 30,000 tons used annually in Senegal, some 12,000 tons are being used on peanuts; 13,000 on sorghum, millet, and corn; 2,000 tons on cotton; and 3,000 tons on rice. Estimated cost of fertilizer production is $100 per ton, but farmer cost regardless of grade is $50 per ton, the rest subsidized by the state. Of the 10 grades of fertilizer produced, most are low concentration formulas, with some 45 per cent of the production being 14-7-7. Higher concentration formulas would save substantially on transportation costs.

6. Farm to market roads are limited in relation to need, and limit the productive use of some high rainfall, good soil areas. Transportation costs are high (12 CFA per ton/mile on hard surface roads, 20 CFA per ton/mile on improved non-hard surface roads, 28 CFA on unimproved roads, and 38 CFA on bad roads).

7. Except for peanut producers in cooperatives, farm credit on favorable terms has been limited or non-existent.

8. While the use of animal-drawn equipment is making substantial progress, and the equipment seems in general well-designed, the seeders, and particularly the seeder plates, are not well adapted to millet and sorghum. As a consequence excessive quantities of seed are planted, requiring hand thinning at a time when labor is needed for other tasks.

Senegalese institutions which will be concerned with a grain production and stabilization program are ONCAD, IRAT, and the Agricultural Service of the Ministry of Rural Development. Working

with them in the extension field in the peanut basin are SODEVA and the Institute of Food Technology (ITA).

ONCAD, established in 1966 from earlier marketing organizations dating back to the colonial period, has two major areas of responsibilities:

1. On internal markets, and insofar as the production of agricultural cooperatives is concerned, ONCAD is charged on the one hand with furnishing all agricultural inputs -- machinery and other material, seeds, fungicides, fertilizers, insecticides, etc. -- and on the other hand with the collection and resale of their production.

2. ONCAD is also the policy instrument of the state in development and promotion of cooperatives.

These amount to substantial responsibilities. For example, in 1972 this amounted to the collection of some 750,000 tons of peanuts from nearly 2,000 cooperatives and their storage and resale to oil mills or export and provision of 2.3 billion CFA worth of seed and 1.5 billion CFA worth of agricultural equipment.

ONCAD is organized on a regional basis, with its infrastructure located principally in the provinces of Sine-Saloum, Thies, and Diourbel. It employs some 1,860 full-time personnel and 1,500 part-time laborers.

In a recent reorganization, the rice marketing agency was incorporated into ONCAD, adding 124 agents and responsibility for the importation, storage, and distribution of rice in the country.

ONCAD is charged with the execution of the millet-cereal stabilization program, but has not been active due to a serious lack of resources and direction. As a result, although the agency has bought and sold small quantities of local sorghum and millet almost every year and is responsible for storage and distribution of donated grain, no real planning for implementation of the overall government stabilization policy has been done, other than annual announcement of an official buying price.

ONCAD has in the past had a spotty reputation in some areas -- charges of bureaucratic inefficiency, even corruption, can be turned up fairly easily. The agency has suffered in the past from some incompetent or untrained people it has inherited in earlier reorganizations. A recent report calls the major inefficiency the tendency of staff to buck decisions upstairs. Farmer disenchantment due to slow payment, payment in unredeemable script, etc., has run high in the past.

Substantial changes are evident. ONCAD has received World Bank financing which has enabled it to improve its efficiency, particularly

in its field operations and its dealings with cooperatives. It appears that its reputation with the farmer it serves has improved. It has also benefitted over the past 2 years from a substantial input of management assistance and consultation from the firm Ital Consult.

Certainly the study team was favorably impressed with the cadre it met. There is no question the organization has the experienced and trainable personnel to implement an efficient grain stabilization program, if a serious decision is taken at higher levels of the government and in the organization itself that it should do so.

IRAT appears to be one of the most competent research organizations of its type the study team has seen in Africa. A large well-equipped, well-staffed research center at Bambey is supported by a number of sub-centers in other sections of the country. Research results are tested in pre-extension trials in typical villages and farms before being recommended to the farmer. There appears to be excellent working relationships and rapport between research and extension officers, and coordination between programs.

Problems of millet and sorghum agriculture are receiving adequate attention not only in the areas of variety development and cultural practices but also in agro-economic studies, machinery development, and storage techniques.

Field work in agricultural development and extension is the responsibility of the Service Chief of the Ministry of Rural Development in each regional office. Working under him are extension agents, usually insufficient in numbers for the responsibilities assigned to them and often limited in such important areas as vehicles, gas, and support materials. The study team was very favorably impressed with the energy, competence, and comprehensive experience of the Service Chiefs it met.

Extension work in the important peanut basin is reinforced by the cadre of SODEVA, which substantially increases the number of agents in these three provinces. SODEVA is being developed under the tutelage of a French development company to serve as the agency responsible for all extension work within the peanut basin. SODEVA gives the impression of a very competent young agency, capable of considerable initiative.

The Institut de Technologie Alimentaire (ITA) is one of Senegal's most positive assets in the accomplishment of a grain commercialization program. ITA, benefitting from assistance of FAO technicians, excellent facilities, and very capable leadership, has already conducted a number of activities and research programs on cereal grains. It has produced several first rate studies on the overall problems of cereal production and marketing, is working on the introduction of higher proportions of sorghum flour in bread baking, and has introduced an extensive field testing program on air tight grain

storage in sealed drums, to cite only a few activities. It is also set up to conduct technician level training on grain storage and treatment and has conducted several of these courses for personnel from French speaking countries. The grain stabilization program should count on ITA as an important source of input into research and training.

In summary, the major factors inhibiting the production and marketing of cereal grains, in a descending order of urgency are:

1. Failure of the official marketing agency to effectively carry out the existing grain marketing policy of the Government of Senegal or to develop the necessary detailed planning.

2. Need for a restructuring within the ONCAD organizational framework to give priority and the opportunity for effective program development to grain stabilization.

3. Complete lack of adequate storage facilities at both collection and distribution levels.

4. Shortages of trained cadre in both the managerial and technical aspects of grain storage and grain stabilization.

5. Deficiencies in cooperative organization which limit their effectiveness in the grain collection effort; also the relative scarcity of cooperatives in certain areas.

6. Need for more effective collaboration between the agriculture production/extension agencies and the marketing agency.

Although this is a rather discouraging list of deficiencies, the study team nevertheless feels that an effective stabilization program can be developed if sufficient resources can be directed toward the resolution of these deficiencies. Senegal's assets are also considerable -- a grain marketing policy; an experienced marketing agency; very capable agriculture production institutions in IRAT, SODEVA, and ITA; a fairly well distributed structure of cooperatives; and a better transportation system than most West African countries.

The deficiencies listed above, particularly the lack of adequate infrastructure, are of such a nature that the study team believes the ultimate goal of this project, that is, the increase of food production commensurate with needs and the concurrent development of a stabilized food grain market, cannot be anticipated within the first 3 years of this project. It will take at least 5 to 10 years to attain this goal. Project goals, assumptions, inputs, and outputs will be stated for the program life of 3 years, but will anticipate that the project will be continued for the time necessary to achieve that ultimate goal.

REGIONAL AND PROJECT GOALS

SECTOR GOAL

The sector goal, measurements of goal achievement, and assumptions about goal achievement are documented in the appropriate section of the project PROP.

PROJECT GOALS--SENEGALESE COMPONENT OF THE OMVS REGIONAL GRAIN STABILIZATION PROJECT

The project goals for the Senegalese component of this project are:

1. To assist the Senegalese Government develop its present grain policy into a long-term supply-management and storage plan, including facility requirements and specifications.

2. To assist the Senegalese Government develop an investment schedule of program inputs which will be required to support a viable program of supply management.

3. To assist the Senegalese Government identify, collect, and evaluate the data required to develop an effective food grain program and ascertain the economic, social, and political results of such alternative policies.

4. To assist the Senegalese Government develop the infrastructure, including physical facilities, necessary for a supply management program.

5. To assist ONCAD develop within its cadre the managerial and technical skills to carry out an effective grain stabilization program.

6. To assist ONCAD develop improved financial, accounting, and inventory management practices for a government stabilization program and develop and implement efficient procurement distribution and transport practices.

7. To assist ONCAD develop an effective program of grain sanitation and damage control to reduce storage losses.

8. To assist ONCAD develop a public storage component in its overall program under which they can issue negotiable certificates and warrants.

9. To help ITA establish a training facility, faculty, and course design necessary to forming a grain stabilization cadre.

10. To achieve in Senegal a program of food grain stabilization which will be compatible with the programs of member states and with the regional grain stabilization program of OMVS, of which it is a part.

OUTPUTS EXPECTED AT THE END OF THE PROJECT

As stated earlier, the life of this project, 3 years, is not sufficient to obtain the overall sector goal stated in the project paper. Substantial outputs can be achieved, indicative of progress, as follows:

1. Production of food grains, millet, and sorghum in normal years will have attained food consumption requirement levels and will continue to increase at a rate sufficient to meet or exceed these levels.

2. The Senegalese Government will have developed and implemented, with clear-cut support and lines of responsibility, a long-term supply management policy and program of action.

3. The Senegalese Government will have developed an investment schedule of program inputs, including a priority sequence of investment for the supporting marketing infrastructure.

4. A marketing infrastructure at both the primary and secondary levels, including functioning, equipped co-ops; a trained cadre at managerial and technical levels; and bulk storage and distribution facilities, will have been established in at least one region.

5. Plans will have been developed and action taken to assure that a marketing infrastructure is in place and functioning in at least one additional region by the end of the fourth year of the project and in at least one additional region by the end of the fifth year.

6. ONCAD will have:

   a. Reorganized its administrative structure to give the grain stabilization project a position within the organization commensurate with its importance, as well as resources sufficient for it to function effectively.

   b. Designated competent administrators at the national level who will have received the additional training necessary to their effective performance.

   c. Developed and implemented efficient inventory and financial management systems and records.

d. Trained managerial and technical personnel operating a grain stabilization program, including buying, storage, and resale, in at least one region.

e. Developed the capacity of co-ops, their officers, and members in at least one region to the level that they are capable of functioning effectively as a part of the grain marketing system.

f. Concurrently begun implementing a program of cadre and infrastructure formation adequate to expand the grain stabilization program at the rate of one additional region per proceeding year of the project.

g. Implemented insect and other pest control programs in all cereal grain storage to the point where storage losses are reduced to less than 2.5 percent.

h. Achieved a measurable effect on supply availability and prices as a result of the program in all of the country, and a substantial effect in the operational region.

i. Increased its efficiency and established its price levels to cover costs.

j. Implemented a public storage program with issuance of negotiable warrants and certificates acceptable in the financial community as security.

7. The Institute of Food Technology will have:

   a. Expanded its facilities, faculty, and course offerings to a point where it is capable of handling all middle level management and technician training for all OMVS countries.

   b. Completed training of the cadre for the operational region.

   c. Begun training and/or be planning for cadre training for regions scheduled to become operational.

8. A policy analysis unit will have been established; an initial study will have been made of the political, social, and economic effects of the marketing policy; a long-term ongoing study of this type will have been designed and implemented; and a statistical reporting system will have been established to support the policy unit.

9. Substantial increases will have been effected in the use of selected seed of improved varieties, high analysis

fertilizer, animal traction, and herbicides, and an improved style of seeder will be available.

10. Food grain prices will have dropped somewhat from their present level of 17 CFA at the farm, but will not reach world market level until at least the fifth year of the project.

BASIC ASSUMPTIONS ABOUT OUTPUTS

There are several basic assumptions made regarding outputs. These are as follow:

1. The planning, implementation, and time phasing of this project will be allowed considerable flexibility. There will be continuing review and revision as required by changed conditions, new or more completely developed information, accelerated inputs from other sources, the development of more promising alternatives, improved technology, etc.

2. The Government of Senegal will continue to manifest an active interest in this project throughout its operation; will express this interest through policy, personnel, and budget support; and will be able to communicate this interest on a continuing basis to all action agencies involved.

3. The production outcome and the changes in production technology listed earlier are in the process of being achieved with resources already engaged and do not require substantial direct support from this project at this time. However, if experience shows this is not the case, it is anticipated that resources available to the project could be directed to support specific production activities.

4. All marketing policies developed and implemented within the context of the Senegal project will be developed in close collaboration with OMVS and in harmony with that organization's overall policies and goals. It is further assumed that the GOS will support this regional harmony.

5. ONCAD, in its grain stabilization policy, will not attempt monopoly control of the market but will rely on and, in fact, assist in facilitating the role of private dealers on the market.

STATEMENT OF PROJECT INPUTS

PERSONNEL

Advisory personnel required in the Senegal component of the OMVS Regional Grain Stabilization Project and the major responsibilities of each are indicated below.

Regional Grain Marketing Advisor

USAID will provide, on a regional basis, one grain marketing advisor for OMVS. His primary area of expertise will be grain market policy and market development (including pricing, market analysis, policy formulation, and evaluation). This advisor will:

a. Serve as team leader of all advisors funded under this project and will coordinate all of their activities.

b. Be responsible for working with the governments of the respective cooperative countries in formulating market policies and procedures which are consistent and regionally compatible.

Man-months devoted to each country will depend on country program requirements. Base of operations will be Dakar.

The advisor will be responsible for the following activities:

a. Advise the appropriate GOS agencies to formulate a comprehensive market development plan, including necessary changes in organizational structure, methods of financing, and operational procedures.

b. Assist the appropriate GOS agencies to formulate a comprehensive market development plan, including necessary changes in organizational structure, methods of financing, and operational procedures.

c. Assist appropriate agencies of the GOS to develop present and anticipated program costs and to utilize to the maximum extent the resources of the private sector toward an efficient stabilization program.

d. Assist appropriate GOS agencies determine the kinds of data required to formulate market policy, and to develop a system for the collection and analysis of appropriate data.

e. Assist appropriate agencies of the GOS to carry out market surveys, project commodity supply and demand schedules, and prepare long-term storage and handling facility plans.

f. Assist in the documentation and presentation of development loan justifications and backup data for the grain marketing program.

g. Coordinate Senegalese policy, planning, and implementation activities with those of other member countries and the regional association.

Agricultural Finance Specialist

USAID will provide one agricultural finance specialist for OMVS. His primary area of expertise will be corporate financing with emphasis on grain or related agricultural commodity financing. Previously he will have been with a corporation heavily committed to grain or related agricultural commodities or the corporation finance section of a commercial bank working with this type of corporation.

The advisor will advise OMVS on financial matters related to and evolving from the commercial grain marketing effort. He will coordinate his work with other regional and national advisors on financing, marketing, and transporting of commercial quantities of grain.

Man-months devoted to each country will depend on the development of their individual financial capabilities. The base of operation will be Dakar.

The specialist will advise and assist in the following:

a. Developing projections of the total capital necessary to provide the assets needed for an on-going national and regional grain marketing system.

b. Determinating reasonable plans for financing these assets through available credit sources and national and individual investments.

c. Recommending functional financial policies at national and regional levels.

d. Aiding regional and national officers and employees to understand the benefits of a healthy private grain trade to operate in conjunction with government controlled grain marketing systems; recommending appropriate government policies to facilitate simultaneous existence of the two (private and public) compatible systems.

e. Developing long-range projections of capital requirements for each national agency working with the project.

f. Establishing uniform procedures of recording and reporting financial transactions related to this field.

g. Developing debt retirement plans.

h. Developing uniform regional policies and working to establish national policies and procedures to encourage a public warehousing system trusted and respected by the banking community.

i. Developing, for spokesmen for the private grain trade, background material and necessary supporting data for presentation to the financial community.

The team recommends this position be filled by a well qualified third-country national with a background in agricultural financing in Europe and West Africa.

Agricultural Engineer

USAID will provide one agricultural engineer for OMVS. His primary area of expertise will be storage facility and equipment design, construction, and maintenance. This advisor will work with the governments of the cooperating countries to formulate policies and procedures which are consistent and regionally compatible. Base of operations: Dakar. Man-months devoted to each country will depend on country program requirements.

This advisor will be responsible for the following activities:

a. Advise regional and national officials on the most appropriate storage facility design for use at secondary and primary markets.

b. Assist in determining locations of secondary market facilities.

c. Cooperate with IRAT and ITA in the design of primary level market facilities.

d. Assist IRAT and ITA in design of on-the-farm storage facilities.

e. Assist in design of the simplest type of grain handling equipment.

f. Recommend common type facilities and equipment for use by all OMVS members.

g. Review all construction blueprints with appropriate government officials prior to offering these for bid.

h. Review and make acceptance recommendations on all construction bids and equipment purchases.

i. Act as on-the-job inspector for the government during construction of all storage facilities at the secondary level.

j. Assist ITA in developing courses on equipment maintenance.

k. Assist IRAT in design and development of threshing and milling equipment to be used at primary markets on a custom basis.

l. Develop a continuing preventive maintenance program for all handling and storage equipment.

Grain Marketing Specialist

USAID will provide one grain marketing specialist whose primary responsibility in Senegal will be to work with ONCAD on program organization, management record systems, inventory control, quality control, development of long-term warehousing requirements of the primary and secondary level, field organization, and training. Base of operations: Dakar.

The grain marketing specialist will be responsible in Senegal for the following activities:

a. Serve as general marketing advisor to the management of ONCAD.

b. Assist ONCAD restructure the grain commercialization section within the ONCAD organization.

c. Assist ONCAD's management in researching and developing an improved system of inventory management, record control system, and storage, handling, and cost analysis procedures.

d. Assist ONCAD develop storage facility designs as well as location and storage projections, in collaboration with the regional grain marketing advisor and, as needed, engineering consultants.

e. Assist ONCAD implement improved handling and transport procedures.

f. Assist ONCAD management plan, conduct, and evaluate market surveys and other types of data acquisition procedures.

g. Assist ONCAD and ITA develop and implement middle management and technician training programs in such areas as procurement, transport, handling, receiving, record maintenance, quality control, storage techniques, etc.

h. Assist ONCAD develop and implement an insect, rodent, and pest control system in its warehouses.

i. Assist ONCAD and SODEVA in developing and initiating a cooperative training and activities program in grain marketing.

j. Assist ONCAD in cooperation with ITA develop a simple but relevant set of grain standards and to put them into practice.

Consultants

USAID agrees to provide, in addition to the project-funded technical assistance advisors described above, short-term consultants as the programs require and as mutually agreed upon by donor and donee. It is anticipated that additional consultant assistance will definitely be required in the area of engineering design, and very probably in the area of transport. For purposes of budget calculations, a total of 10 months consulting assistance per year to meet all regional needs has been provided.

TRAINING

Executive Development

The following is considered the minimum level of executive development required under the project. Such training should be planned to commence as soon as the Government of Senegal has assigned personnel to the designated positions and they can be taught English. All training should be very carefully specified by the regional marketing advisor and should be specially tailored to the past experience and training or each candidate. Resident academic training would be conducted at the Food and Feed Grain Institute at Kansas State University.

a. Director or Deputy Director, Grain Stabilization Program. A 5-month resident program including 3 months grain marketing, 1 month grain cooperative credit, and 1 month warehousing and handling. The academic training would ideally be concluded with a 1-month field assignment to a large grain cooperative such as the Far-Mar-Co in Kansas City or the Arkansas Rice Producers Cooperative.

b. Chief, Grain Sanitation Program. The Senegalese designated as responsible for the sanitation program at both primary and secondary facilities should receive 3 months academic training in all aspects of fungi, mold, insect, rodent, and other pest control at Kansas State. This should include substantial opportunity to observe sanitation programs in operation in the field.

c. Superintendent, first grain storage facility. This official should be provided with a minimum 3 months of resident training in warehousing management and techniques at Kansas State plus a 1-month opportunity for an on-the-job training assignment to a comparable grain storage facility in the United States.

It is anticipated that all participants will be given English language training if needed. If this is not feasible, training will be arranged through ITA for comparable training either at ITA or in a French-speaking third country.

Middle Management and Technicial Level Training

It is difficult at this point to specify the amount of middle management and technician level training which will have to be conducted, but most personnel involved with the program will require initial training and all will require periodic retraining. An excellent facility with experience in this field already exists in Dakar. The Director of ITA has indicated a strong interest in active participation in the project. Attention must first be given to providing ITA with working copies of warehousing equipment to be used, some lab equipment, and course outlines. Concurrently the grain marketing advisor, in collaboration with the ONCAD director of grain marketing and the ITA faculty, can develop and project specific training needs. Training will need to include units on procurement, receiving and handling, transport, record keeping and accounting, grain handling, sanitation, fumigation, grain standards, care and condition of grain, storage techniques, and operation and maintenance of handling equipment.

Equipment to be furnished ITA to enable it to conduct project training is listed in Appendix A.

INFRASTRUCTURE

One of the most important factors in the success of a grain marketing program is the existence of adequate storage at three levels -- on-the-farm, at buying points, and in major consumption areas. Other studies in Senegal have labeled buying point storage as primary and larger storage in consumption areas as secondary; we have followed this nomenclature in this report.

Secondary Storage

It is estimated that between 100,000 and 200,000 tons of millet and sorghum are presently commercialized out of production of 650,000 tons. Normal year production will probably climb to 800,000 tons during the life of this project and farmers will attempt to market a higher percentage of this increment. The team feels that the project will require a secondary storage capacity of not less than 25,000 to 30,000 tons to be effective in a grain stabilization program.

This storage does not exist and should be provided under a loan arrangement either with AID or with other credit sources available to the GOS. The study team recommends that a facility of

approximately 5,000 ton capacity be constructed in each of the three regions of the peanut basin, one in the Dakar area, and one each in the producing regions of Senegal Oriental and the Fleuve. One of the first responsibilities of the OMVS and ONCAD marketing advisors will be to study the most advantageous locations and the exact sequence of contruction by location. It appears to the project study group that either the Diourbel or Sine-Saloum region offer the best opportunity for location of the first warehouse.

A warehousing unit will consist of two flat storage type warehouses, each with a capacity of approximately 2,500 metric tons. The buildings shall be constructed of reinforced concrete, and sides and exterior walls must be grain-bearing. The building must be reasonably tight, but not hermetically sealed.

A building 60 feet by 130 feet by 20 feet divided by a common wall down the length and two equally spaced interior walls at right angles from the outer walls will provide six bins of 430 metric ton capacity each. Each bin will communicate with adjacent bins by a doorway 8 feet by 5 feet. The roof will crown at the center to a height of 22 feet. Each of the bins and the building will be capable of being sealed so that individual bins or the entire building can be fumigated.

Buildings would be separated by a 15 foot driveway, and all outside doors should face this driveway. One of the buildings should be adjacent to a railroad siding and should be served by an all-weather road. The two buildings should be connected with overhead and ground level conveyors.

Equipment recommended for this type facility can be operated and maintained satisfactorily in Senegal, the team believes. Specific lists of equipment required and additional construction details are contained in Appendix A.

Primary Storage

The study team proposes that farm cooperatives be used as grain buying organizations. Large numbers of cooperatives are already in existence and they do possess a certain infrastructure. Some even own small flat storage warehouses, remnants of an earlier program.

ONCAD is currently proposing the strengthening of co-ops and their consolidation into stronger economic units. The grain stabilization program could serve as an element in that strengthening.

Co-ops selected as buying points should be encouraged to build four or five of the small round IRAT-type concrete bulk silo storage units of approximately 3 tons capacity each. These could be built in a semi-circle, to be loaded by a small portable screw conveyor

powered by a 5 to 7-1/2 hp gas engine. Trucks could be loaded rapidly by placing that conveyor at each tank's discharge valve. Co-ops should be encouraged to sell to any licensed grain dealer as well as to ONCAD, as long as the price were equal to or better than the established market price. This buying and short-term storage transaction would add to the co-op's income.

Location and labor for site construction would be furnished by the co-op. Steel and concrete would have to be supplied either by grant or by long-term loan. If by grant, co-ops should be required to put up at least a part of the capital outlay to increase their interest in the program. As an auxiliary part of the program, a number of cooperatives could be supplied with a small threshing machine to perform this service on a custom basis and to test the demand for the service.

ONCAD should extend their sanitation service to the co-op storage facilities.

The study group suggests that consideration be given to the development of this system of co-op buying points during the initial 3 years of the project, not only in support of the first secondary grain storage to be built in the peanut basin, but also in the major surplus region, Senegal Oriental.

Farm Level Storage

Farm granaries in Senegal where millet and sorghum are stored on the head are remarkably free of damage problems in most seasons. These granaries are constructed of local material and are very inexpensive. The extension services and local authorities, as part of the stabilization program, should increase their efforts to encourage farm level storage.

SODEVA is conducting a fairly large pilot program to test the efficiency of IRAT-style concrete silos for storage of threshed grain on the farm. This is an interesting effort in terms of the grain marketing program and, while the study team does not feel the system at present is economically feasible, we recommend the grain stabilization advisors keep abreast of results from using IRAT concrete silos and lend support where it promises to give positive results.

WORKING CAPITAL

ONCAD's cost of handling grain for the crop year 1970-71 was 28.745 CFA per kg. of grain handled. Assuming the organization might handle 2,000 to 3,000 tons of grain with the activation of the first set of facilities (approximately the third year of the project), a working capital of up to $345,000 would be required. As the tonnage of grain handled increased to 35,000 tons, working capital requirements would reach $4 million.

In its operations up to this point ONCAD has not covered costs of the grain program and has in fact suffered a loss of $2.70 per ton. It is imperative that buying and selling costs be adjusted to assure that ONCAD's costs be covered in the grain stabilization program.

The study team recommends that one source of ONCAD working capital be found in a one CFA per kilogram tax on imported rice. This tax would net approximately $800,000 per year for the program at present levels of rice importation.

BASIC ASSUMPTIONS ABOUT PROJECT INPUTS

The following assumptions are made regarding project inputs:

1. That AID can recruit personnel in a timely manner who have the requisite qualifications of education and experience and who speak French at a minimum level of FSI-3.

2. That any AID personnel recruited to the program who do not speak French at a level of a minimum FSI-3 will receive training to arrive at that level before they are assigned to post.

3. That AID personnel assigned to the project not only be qualified technically and linguistically, but also be capable of functioning effectively in a different environment and, above all, be able to establish effective working relationships and rapport with their Senegalese counterparts and co-workers.

4. That a pool of capable experienced management personnel exists within the ONCAD cadre, and these could be designated and programmed for training at an early date.

5. That the Government of Senegal and its action agencies will assign capable, active, interested personnel to all levels of the project; will make them available for training; and will assign them to the responsibilities for which they have been trained.

6. That the action agencies of the GOS give wholehearted support to an effective program; that they develop effective mechanism, both official and informal, for close cooperation and collaboration; and that they offer the opportunity for close working relationships and support to AID project personnel.

7. That a substantial training capability for middle management and technical personnel already exists within the Institute of Food Technology; that this could be made

adequate for OMVS regional needs and possibly for Entente personnel with a small expansion of physical plant and equipment; and that training could be started almost immediately.

8. That the use of existing ONCAD cooperatives as an important link in the marketing chain, that is as primary level buying and stocking points, is in consonance with ONCAD's plans as delineated by Ital Consult to revitalize cooperatives and give them a more active and independent role in rural development activities.

9. That if necessary the resources of SODEVA might be called upon to assist in the training of cooperative members and their organizations to perform this marketing function, and that SODEVA would be interested in conducting this training as part of their extension program.

0. That the Senegalese Government, through its action agencies and particularly through SODEVA, will continue its effort to encourage farmers to construct on-the-farm storage granaries, and that this effort will be reasonably successful.

11. That loan financing for a substantial infrastructure building program will be available.

12. That substantial working capital for a grain buying program building up to a level of 25,000 to 35,000 tons will be available.

BUDGET

PERSONNEL

Technical assistance personnel assigned to the Senegalese component of the grain program include a grain marketing advisor and a grain marketing specialist.

The grain marketing specialist will serve full time in Senegal and, for budgeting purposes, we have assumed he will have been recruited and given French training if necessary in time to assume his duties by July 1, 1973.

The grain marketing advisor will divide his time among OMVS and the three countries. Since he is stationed in Dakar, we have, for simplicity, assigned his full costs against the budget for the Senegalese program. We have assumed, probably optimistically, that he can be recruited, given language training, and be on board by January 1, 1973.

Grain Marketing Advisor

	FY-73 (6 mos.)	FY-74	FY-75
Salary	15,000	30,000	32,000
Language	5,000	---	---
Travel to Post	4,000	---	---
Education	1,500	3,000	3,000
Housing	4,000	8,000	8,000
Differential	---	---	---
Overhead	---	---	---
Per Diem (100 days, @ $25.00)	1,500	2,500	2,500
Equipment Vehicle (Rio)	3,500	500	500
Prof. Equip.	2,500	500	500
On-the-job Travel			
Surface (10,000 miles @ $0.15)	900	1,500	1,500
Air	1,000	2,000	2,000
TOTAL	38,900	48,900	54,000

Agricultural Finance Specialist

	FY-73 (6 mos.)	FY-74	FY-75
Salary	15,000	30,000	32,000
Travel to Post	4,000	---	---
Education	1,500	3,000	3,000
Housing	4,000	8,000	8,000
Differential	---	---	---
Overhead	---	---	---
Per Diem (100 days $25.00)	1,500	2,500	2,500
Equipment Vehicle (Rio)	3,500	500	500
Prof. Equip.	2,500	500	500
On-the-job Travel			
Surface (10,000 miles @ $0.15)	900	1,500	1,500
Air	1,000	2,000	2,000
TOTAL	33,900	48,900	54,000

Agricultural Engineer

	FY-73 (6 mos.)	FY-74	FY-75
Salary	15,000	30,000	32,000
Language	5,000	---	---
Travel to Post	4,000	---	---
Education	1,500	3,000	3,000
Housing	4,000	8,000	8,000
Differential	---	---	---
Overhead	---	---	---
Per Diem (100 days, @ $25.00)	1,500	2,500	2,500
Equipment			
Vehicle (Rio)	3,500	500	500
Prof. Equip.	2,500	500	500
On-the-job Travel			
Surface (10,000 miles @ $0.15)	900	1,500	1,500
Air	1,000	2,000	2,000
TOTAL	38,900	48,900	54,000

Grain Marketing Specialist

	FY-74	FY-75
Salary	23,000	30,000
Language	5,000	---
Travel to Post	4,000	---
Education	3,000	3,000
Housing	8,000	8,000
Differential	---	---
Overhead	---	---
Per Diem (100 days $25 per day)	2,500	2,500
Equipment		
Vehicle (land rover)	5,500	500
Prof. Equip.	500	200
On-the-job Travel		
Surface (10,000 miles @ $0.20)	2,000	2,000
Air	1,000	1,000
TOTAL	59,500	47,200

Consultative Services

FY-73	FY-74	FY-75
$3,750	15,000	15,000

These estimates are calculated on the basis of 2 months per staff member per year at the rate of $3,750 per month (salary plus per diem plus travel).

TRAINING

Executive Development

Based on five participants, a total of 18 months training at Kansas State, with provision for educational travel and on-the-job training would cost:

FY-73	FY-74	FY-75
$4,000	6,600	6,600

This assumes training for one program director FY-73; one warehouse supervisor and one sanitation supervisor FY-74; and two warehouse supervisors FY-75.

Middle Management and Technician Training

	FY-73	FY-74	FY-75
Equipment--ITA lab installed	25,000	2,000	2,000
Middle management training at $150/ trainee week	2,500	15,000	18,000
Technician training at $150/trainee week	2,500	15,000	18,000

INFRASTRUCTURE

Secondary Level

Based on previous construction experience in Senegal and team calculations, the recommended construction will cost $80 per ton or $400,000 per facility. A minimum of five such storage facilities are recommended for a total of $2 million. Time phasing of expenditures will depend on later decisions concerning the speed at which the program will attain its 25,000 metric ton storage goal and whether that facility proves to be adequate to stabilize the market.

The team has recommended that at least one storage facility be in operation by the completion of the first phase of the project (the end of the third year), and that one additional facility be completed in each subsequent year of the project until planned capacity is reached. Expenditures for the first 3 years would in this case approximate the following:

FY-73	FY-74	FY-75
$100,000	300,000	300,000

Primary Level

Each secondary facility will require a supporting infrastructure of primary buying points at the cooperative level. It is reasonable to expect that cooperatives participating in the buying program would each construct a storage capacity of 12 to 15 metric tons, and that approximately 100 buying points might be required to support each major storage facility. At a cost of $40 per ton of storage for cement and steel, and assuming cooperatives would furnish labor, land, sand, gravel, and at least 10 per cent of the cash investment, each cooperative would require $540 or a total of $54,000 in support of each major storage facility.

The team also recommends the construction of cooperative buying points and facilities in Senegal Oriental starting early in the program.

Based on these assumptions, the budget for the first 3 years of the program is as follows:

	FY-73	FY-74	FY-75
Secondary	100,000	300,000	300,000
Primary	5,000[5/]	---	---
1st Facility	---	27,000	27,000
2nd Facility	---	10,000	20,000
3rd Facility	---	---	10,000
Senegal Oriental	---	5,400	8,100

5/ Research and development costs to IRAT to adopt structure to co-op requirements.

APPENDIX A--MARKETING

All cabinet members should completely understand the regional grain stabilization and production program - its cost and the political and economic conditions that will develop within the country if it succeeds as well as the ramifications should the program fail. More than a simple majority of the cabinet should approve the program, and the President should concur with the majority of the cabinet. All should understand that the program may, and undoubtedly will, require a reassessment of other ongoing national programs. New priorities will have to be considered and evaluated. Surely some cabinet members and their departments will have to give up or cut back some ongoing program. Political and administrative discontent could develop in the regions that are the last to be affected by the program.

The legislative body may be requested to enact legislation that will either establish new laws or modify those now controlling the commercial sectors. These include price controls, bonded warehouses, grain standards, methods of debt collection, land tenures, etc.

All should understand that this could and should have a direct effect on every person living in Senegal - a change from a substance to a money economy; a change from a continuing deficit to exportable surplus; and slow but continuous change in the dietary habits of the country, from a basic grain diet to one continuously increasing in the use of meat, poultry, and vegetables.

ACTION AGENCY

A cabinet officer needs to assure coordination between all elements of the program. The production, commercialization, and credit function may fall under two or more ministries, departments, or independent agencies, but one minister should be the final arbitrator or decisionmaker for the expenditure of funds, manpower, training, and production inputs.

COMMERCIALIZATION

ONCAD now offers the basic framework on which the grain marketing and handling program at both the primary and secondary levels could be developed. It has administrative and technically trained personnel at headquarters and regional levels. It has physical assets such as land, buildings, transporting equipment, handling equipment, repair shops, etc. It has established reporting lines, both in the administrative and technical fields, and is in daily contact with almost every segment of society within the country. It has experience in handling the basic agricultural inputs necessary to produce a successful crop, including seed, farming equipment, and fertilizer.

It is experienced in the marketing, handling, and transportation of the major agricultural crop as well as the major food grain imported. Peanuts, rice, and donated food grains are handled in a workman-like manner and have reached the break-even point or shown a profit.

This experience has not enabled them to successfully handle domestic food grains, even in small quantities, however, They lack technical skills in grain marketing and handling; adequate storage facilities, proper administrative controls, administrative drive or spirit, and proper finances to stand the losses incurred.

WORKING CAPITAL

ONCAD's cost of handling grain during the crop year 1970-71 was 28.745 CFA per kg. handled. With a sales price of 22.000 CFA per kg., this resulted in a loss of 6.745 CFA per kg. 1/

With activation of one secondary marketing facility and several primary marketing facilities at the co-op level, ONCAD could acquire 3,000 to 4,000 tons at the secondary facility the first crop year. Based on 1970-71 costs, this could require a cash flow per kg. acquired of 25.747 CFA.(see tabulation below).

Packaging material	1.742
Weighted producer price	17.139
Transportation	6.766
Co-op weigher's charge	.100
Total acquisition cost	25.747

This would require between 76,000,000 and 100,000,000 CFA (U.S. $300,000 and $400,000) to acquire and transport the inventory. This would not include the cost of operating or financing the secondary facility for the crop year.

Again based on 1970-71 crop year, ONCAD showed operating costs of 2.998 CFA per kg. broken down as follows:

Handling	.006
Insect control	.515
Insurance	.030
Financial	1.465
General expenditures	.829
Storage and up-keep	.153
Total operating cost	2.998

Acquisition cost	25.747
Operating cost	2.998
Total costs	28.745

This would be a total cash flow of U.S. $345,000 to $440,000 per crop year for one facility.

1/ R. Mangolini, Markets and Marketing Methods for Local Cereals in Senegal, August 27, 1971, p. 7; A Study and Plan for Regional Grain Stabilization in West Africa, Kansas State University, December 1970, page 177.

Should the selling price remain as set for the 1970-71 crop (22 CFA per kg.), the loss would amount to between U.S. $80,000 and $107,000, or about a quarter of the cash flow.

Until there has been a realistic adjustment in the price paid to the producer and the price paid by the consumer, this loss will continue and could be increased for several years at the beginning of the new program. A potential source of building working capital would be an additional tax of 0.5 CFA per kg. on imported rice. This would net between U.S. $300,000 and $400,000 per year. Other sources might be PL 480 funds and grants from foundations or other foreign aid groups.

INVESTMENT CAPITAL

To build and equip adequate secondary marketing facilities could cost up to $80 per ton of capacity; capacity to handle 25,000 to 50,000 tons would thus cost U.S. $2-4 million.

At the primary or co-op level, to use the silo developed by IRAT would cost $15 per ton. Each primary market should be equipped with four tanks, giving a total capacity of 12 tons; this would cost $180 per station. Possibly 50 of these primary co-op stations would serve one secondary market. This would make $45,000 to $90,000 additional capital needed. This could be added to original loan, making it total U.S. $2,050,000 to $4,100,000. This could be spread over a 5 year building program. The source of the financing might be AID, the World Bank, or other development agencies.

TRAINING

Academic Level

Marketing: One college level administrative man should be trained in marketing to become the Director or Deputy Director of the grain program. His training should include 3 months on grain marketing, 1 month on grain credit cooperatives, 1 month on grain warehousing and handling, and 1 month with integrated grain and rice co-ops. AID, in cooperation with Kansas State University, could work out a special program which would include 5 months on campus and 1 month divided between a large grain co-op such as FAR-MAR-CO in Kansas City and Arkansas Rice Producers in Arkansas.

Sanitation: The man who is going to supervise the sanitation program for all facilities, both primary and secondary, should also be trained. If he speaks English, 3 months at Kansas State University is recommended. His program should include 1 month on grain sanitation, 1 month on fumigation, and 1 month on grain handling.

If this man does not speak English, the Institut de Technologie Alimentaire and IRAT should determine what French or African school might be appropriate for a 3-month training program. The subjects covered in the training should be as outlined above.

Grain Handling: This training should be for the superintendent of the first grain handling facility built; he should have the ability to pass on his training to the other superintendent. If this man speaks English, Kansas State University is recommended for 3 months of training on warehousing. If he doesn't speak English, ITA and IRAT should determine an appropriate French or African school.

Trade School Level

All personnel to be employed at primary and secondary facilities above the labor level should attend classes at Institut de Technologie Alimentaire on grain handling, sanitation, fumigation, grain standards, care and condition of grain, and repair of handling equipment. Special classes could also be worked out among ITA, IRAT, and ONCAD, with the support of AID.

On-the-Job Training

AID's agricultural engineer, coordinating with the Director of the grain program, should set up an on-the-job training program which would include training guides, reading material, actual observation of the man at work, and classroom training sessions at the storage facility. He should give supervisors a monthly written evaluation of each employee at the primary and secondary markets, with a copy to the Director.

Each AID employee assigned to the grain program shall not only act as an advisor to his counterpart, but shall furnish training guides and reading material; hold bi-weekly seminars with lower level employees; and give tests and maintain a continued written evaluation of each person.

Equipment for Training

In cooperation with ITA, AID should furnish the following equipment to be used as training aids in grain handling and storage:

1	25 ton per hour bucket elevator (leg) about 40 feet in height
1	small cleaner, 2-3 ton per hour
1	automatic scales, 2 bushel
2	screw conveyors, 4 inch diameter and 40 feet in length
	plywood to build 2 hoppers, 5-10 ton capacity
	spouting, 6 inch diameter, 600 feet in length
3	motors 1 - 2 - 3 hp. with controls
	distributor, 6 outlets
2	portable screw conveyors, one 4 inches in diameter, 21 feet long and the other 6 inches in diameter, 27 feet long
1	gas engine to power portable screw
2	sets of grain grading equipment
2	sets of necessary laboratory equipment
2	moisture testers (one electric, one brown-Douval)
1	spray pump and equipment for application of malathion at boot of leg and intake of screw conveyor; also lines for portable application to walls, floor, and top dressing of bulk-stored grain

This equipment should be set up to handle grain, but would also be used as classroom equipment to teach grain handling, cleaning, weighing, and application of malathion. It would also be used as training tools for repair and maintenance. All equipment should be taken apart and put back together by the students so they have actual experience in maintenance, adjustment, and repair.

STORAGE FACILITIES

Farm Level

No major change should be made in the basic storage facility or manner of storage at the village level. Farmers should continue storing their basic needs in the traditional manner. Grain should be stored on the cob or head until needed for consumption or sale.

ITA could, however, make a study of the best traditional storage unit, recommend some improvements, and then publicize this improved type of storage with posters.

ONCAD, through the co-ops, could also offer an annual spray program using malathion on the inside and DDT on the outside of the village storage units after they have been cleaned prior to the next harvest.

Primary Market

All useable flat sack storage facilities at the co-op level should be cleaned and repaired. Written instructions should be developed on storing sacked grain (i.e. pile away from wall, pile off the floor, make secure piles, cover with tarp for fumigation, etc.). Such instructions should be posted where they will be read by all employees - also, they should be in French, local languages, and drawings that will convey the message to the illiterate.

Four of IRAT's 3 ton concrete silos should be built so a truck load of bulk grain can be delivered at any time. These small silos should be built on dry, elevated land, close to the co-op office, and in a semicircle so they may be filled with a portable screw conveyor from a common pit. The same portable conveyor can be used to load the bulk grain into the bulk truck.

IRAT should be requested to work with the co-ops on the building program. The silos should not be built for the co-ops but, rather, the co-ops should be supplied financing and technical help during construction. The co-ops should furnish all construction labor and also be encouraged to make some capital investment in the silos. Several of the larger co-ops should be supplied with two threshing machines to thresh the grain at the co-op. This should be on a custom basis, charging the owner of the grain for use of the machine. The same co-op should also be supplied with one small mill for grain. This would do custom milling for the members at a charge per kg.

With these two machines it would be possible for the co-op to have a year-round income and become a viable economic unit. Should these two machines be accepted, even by a small part of the farm population, they could

become innovators of one of the greatest social changes in Senegal--freeing women from the ever present, time consuming task of daily milling of their food grain.

Should this equipment prove economically sound and be accepted by the members, other co-ops could make the capital investment from savings or a membership assessment.

Secondary Market Level

Storage Unit or Warehouse: The building 60' x 130' x 20' shall be constructed with reinforced concrete foundation, floor, side walls, interior walls, and roof. The side and interior walls must be grain bearing. The building must be reasonably tight, but need not be heretically sealed.

This building should be divided by a common wall down the center and two equally spaced walls on each side at right angles to the center wall to produce 6 bins or compartments. Each bin or compartment should communicate with one adjacent bin or compartment with a doorway 8' x 5'. The roof will crown at the center to a height of 22'. The grain load level should be a depth of 15'. Each bin will hold more than 430 MT of bulk grain. A building of this design also may be used to store different types of commodities or general merchandise not related to bulk grain storage. This building should be gas tight so each compartment or bin can be individually fumigated or the entire building fumigated as a unit.

Handling Equipment: The following handling equipment will be needed:

1 bucket elevator (leg) 50 feet in height, 30 ton per hour capacity
5 screw conveyors, each with a capacity of 30-35 ton per hour (three 130 feet in length and two 60 feet in length)
1 grain cleaner with a capacity of 30-35 ton per hour
1 automatic scales, 2 bushel capacity
1 sacking off hopper
1 truck pit; this pit should be of 20 ton capacity, but divided in the center so either side may feed the leg
1 distributor

necessary spouting

Each of the above units requiring power will be equipped with its own motor.

Flow of Grain: Grain will be dumped in the pit from the bulk truck, or cut in from sacks. It will flow by gravity from pit to boot of the leg, elevated by bucket elevator to head, flow by gravity to distributor, from distributor by gravity to over head screw conveyor located 10 feet above the crown of the roof, conveyed through conveyor to outlet above bin, and finally flow from the conveyor by gravity into the bin.

Outgoing grain would flow from the bin by gravity to the outlet and into the discharge screw conveyor located on each side of the building, running the length with two discharge outlets for each bin. This conveyor would move grain from the bin outlet to the front of the building and into a cross conveyor to the pit, from the pit to the leg, and from the leg to the bulk car, track, or the sacking off hopper to be bagged.

Station or Market: A station or market would consist of two or more of these basic buildings. Two should be built side by side with a 15' alley or driveway between them. All outside doors should face this alley.

One of the buildings should be adjacent to a side track, and all should be next to an all weather road. The two buildings would be connected with overhead and ground level screw conveyors; each of these could be operated independently, and either leg could service both buildings. One could load to a truck while the other could load to a car; both could receive at the same time; one could load out and the other receive; or there could be any combination of the above.

Additional Equipment: Other equipment needed would include:

2 screw conveyors, 60' in length
1 truck sales
1 office, laboratory and shop building
1 set of laboratory equipment
1 portable screw conveyor
1 set of hand tools
spare parts

GRAIN STANDARDS

Simple grain standards should be developed in cooperation with ITA. Suggested grading factors would include moisture, degree of damaged kernels, and amount of foreign material. The standards should involve only 2 numerate grades and a sample grade for each common class of grain. Men would need to be trained to sample, inspect, and certify lots of grain; sample, inspect, and certify all incoming and outgoing grain; and sample, inspect, and certify, by bin, all grain in storage each month.

SANITATION STANDARD

Standards for sanitation and fumigation should also be set in cooperation with ITA. This would include a reporting service, both for inspection and for the work to be performed.

The sanitation program outlined on page 209 through 219 of A Study and Plan for Regional Grain Stabilization in West Africa, by Kansas State University, Dec. 1970, is made part of this report in its entirety. This is reproduced in Appendix C.

MARKETING (PRICE)

The market price must return to the mean average producer his cost of production plus a margin of profit. This would mean an equal number of producers are working above the break even point as those below the profit line. Improved production and marketing methods will gradually increase the number of producers above the break even point. This will tend to slowly reduce the selling price as production increases.

ONCAD's grain price to producers must be based on world market prices plus ocean freight to Dakar and off loading costs. ONCAD should publish this basic price before harvest. This price should have some flexibility below the basic prices in surplus areas and somewhat higher in deficient areas. The basic price should increase on a monthly basis, i.e., a basic price of 15 CFA at harvest would advance by increments of ¼ or ½ CFA per month until it reached 17 CFA. This would give all farmers a ready market at the basic price at harvest, and would encourage the farmer to store on the farm for a better price some months later. They would also have the option of selling part of the harvest and the balance later at a higher price.

If ONCAD will offer a continuing cash market all year in response to supply and demand, the physical regulation of the private trade will be unnecessary. However, such automatic regulation will not be possible until near the completion of this 5 year building and training program. Only when ONCAD has 25-30,000 tons of storage at secondary markets will stabilization be possible. However, a gradual stabilization of the market should be felt during and after the third year of the program.

By the end of this 5 year program, ONCAD's selling price should equal acquisition price paid for grain plus complete handling and storage cost, freight from point of origin, and a reasonable profit to ONCAD. ONCAD will continue to lose money on the grain operation should it be required to sell at less than the above listed cost factors. If the price to consumers is placed at less than cost, there will never develop a viable grain trade in Senegal. By the end of the 5 year grain marketing program, with application of existing and proven production techniques, reduced cost in storage and bulk handling at the secondary and primary markets, and a gradually improving transportation system, the basic price to producers should be 13-12 CFA per kg. and to consumers 17-19 CFA.

LOSS INCURRED DUE TO START-UP

The continuation of the subsidized price to consumers plus costs of starting the system could result in substantial loss per ton handled during the first 3 or 4 years of this program. A major cost factor in starting the storage and handling program is unused capacity. The first secondary market will have a 5,000 ton capacity, but they may only handle 1,000 tons the first year. Labor, depreciating capital, and management costs would then be 5 times higher per ton handled than they will be operating at capacity. Also, a 5,000 ton facility should actually be able to handle between 7,500 and 10,000 tons per season.

Building a cadre of trained manpower for the facilities which will be built in succeeding years will at least double the payroll for the first few years also.

INEFFICIENT OPERATIONS

Lack of skill in operation will increase handling cost. Damaged machinery, out of condition grain, high fumigation cost, spills, etc., will tend to increase cost per unit handled.

SHARE OF THE MARKET

At the present time there are no accurate figures on the amount of grain that is commercialized in Senegal. ONCAD has averaged less than 10,000 tons over the past few years, hitting a high of over 25,000 and a low of less than 5,000 tons per year. Estimates from competent officials range from 25,000 to 300,000 tons per year. From this information, we have concluded that between 100,000 and 200,000 tons are handled by the private sector each year.

During the years ONCAD was active in the market, the private sector no doubt handled considerably more than 200,000 tons. From this we could conclude that ONCAD seldom, if ever, has handled a fifth of the grain that is commercialized in Senegal. To be effective in the market ONCAD should handle 25-30 percent of the grain being commercialized. Hence, ONCAD cannot be a factor in price stabilization until it has the marketing know-how and the storage facilities to handle 25-30,000 tons per year.

SCOPE AND TIMING OF PROGRAM

Farm Level

Producers should continue storing grain on the head or cob at the village level. While they suffer some loss and damage from insects and rodents, this could be reduced to a marked degree by an educational program conducted by ITA through the ONCAD sanitation service. They could offer a pre-harvest spraying program using malathion on the inside and DDT on the outside of the bins.

Continued use of the traditional method of storage would encourage orderly marketing throughout the year by sales at the local co-ops to ONCAD or the private sector. Such action could greatly aid in the stabilization of grain prices. This could materially cut down the amount of storage required by ONCAD, thus reducing the need for larger amounts of international investment capital.

Primary Market Level

The proposed consolidation of small co-ops into larger area co-ops could be the establishment of buying centers. Many of these larger co-ops now have flat storage facilities that could be used for temporary sack storage of grain. The co-ops should be encouraged to build four or five of the IRAT type

concrete bulk silos so they could have a truck load of bulk grain ready for delivery at any time.

This buying and short term storage transaction would add up to the co-op's income. They should be allowed to sell to any private licensed grain merchant who will pay equal to, or better, than the ONCAD market price.

This would require a limited amount of capital expenditure, as the only costs are for the steel and concrete. The location and all labor required in the construction would be supplied by the co-op members. The co-ops should also be requested to furnish at least 10 percent of the required capital to be expended on the project. This expenditure of co-op funds and supplying of labor should make the members feel they had a vested interest in the success of the program.

This would encourage the co-ops to become a marketing factor in the grain trade by offering the private sector a ready source of grain at a reasonable price. Other possible sources of income would be to offer a threshing or milling service on a custom basis. Once they were in the market, they could perform these services on a barter basis; that is, take part of the grain rather than cash. Using barter, the co-op would build an inventory of grain it could sell in its own name to ONCAD or the private sector.

ONCAD should extend its sanitation service to cover not only the co-op's bulk storage but also their sacked facilities. Each co-op facility should be inspected once each month and corrective action taken on an infestation problems. Such action by a member of the stronger co-ops would have a stabilizing effect on the grain price.

Secondary Market Level

The secondary marketing facility has been physically described in the storage section of this report. Only one of these units should be built the first year. At the same time selected co-ops within the trade area should be encouraged to serve as primary markets, or gathering points and points of sale. These first marketing units (i.e. one secondary and several primary units) should go through an entire crop year and then be evaluated by ONCAD, ITA, IRAT, and AID to determine what changes, if any, are to be made in the physical design, training program, grade and standard - pricing policy, and management skills.

Evaluation results should be reported to the top management of each action agency (ONCAD and AID). The action agencies, after accepting or rejecting each term of reference of the evaluation team, should make a joint policy statement on what changes, if any, are to become effective.

Following these new policies, one additional secondary facility and a group of associated primary markets should be developed at the co-op level. The first secondary market and chain of primary markets should be functional by September 1973. The next secondary and primary chain should be functional in September 1974, and the last units by September 1975.

The evaluation team should make an annual review of the entire marketing system each year covering all marketing facilities then in operation. The action agencies should review the report and make those changes necessary, if any. By recognizing the errors, omissions and mistakes originally in the program plan will be corrected before the completion of the program.

PRIVATE GRAIN TRADE

There are no grain dealers in Senegal. However, there are hundreds, if not thousands, who may deal in grain. There is no constant and adequate source of supply from which a moderate size grain dealer may buy. Every dealer must go directly to the farm level to make his purchase. The IRAT-type silo at the village or "co-op" level will aid in establishing a year-round source of grain for the private sector.

PUBLIC STORAGE

ONCAD should offer at least a portion of its proposed storage facilities as a public warehouse. A public warehouse is defined as a storage facility operated by a government agency, a person, partnership, cooperative or corporation engaged in the business of storing goods of others for profit or hire.

Bulk grain is a fungible commodity, i.e., one specimen or part may be used in place of another in the satisfaction of an obligation, as money, grain, or food. Grain is also a commodity that may be commingled by grade and class.

With the establishment of Senegal grain standards, the owner of any lot of grain should be able to deposit such grain for storage at an ONCAD grain storage facility. The owner of this deposited grain could then request ONCAD to deliver grain of the same quantity and quality to him at some future date. For this service the owner would be required to pay to ONCAD their published tariff. Under French statutes, public warehouse may now issue a negotiable warrant and certificate to any depositor having grain on storage in the facility. These negotiable warrants and certificates may be pledged as collateral to secure a bank loan based on the value of the commodity.

APPENDIX B--PRODUCTION

There are almost unlimited possibilities for increasing grain production in Senegal. To accomplish a major or effective increase, however, will require an attractive support price that is in keeping with the alternative uses for the farmers' resources (land, labor, and capital, including credit at a favorable interest rate). Unless millet prices are more attractive than sorghum prices, it is doubtful that much millet will reach the commercial trade. Millett yields are usually much lower than sorghum, so farmers plant just enough millet for home consumption. They grow it for home use, though, because most prefer the taste of millet over that of sorghum.

One of Senegal's assets is a favorable climate. The average rainfall in the major grain producing areas outside the northern third of the country appears to be sufficient to meet crop needs (see rainfall map attached). The difficulty is the wide fluctuation in both amount and distribution from year to year. Yearly production fluctuates widely as a result since the country is relatively small and low yields in one area are not partially offset by high production in another.

Another asset to the nation is its people. They appear industrious and hard working, with a keen analysis of opportunities and an ability to preserve life on limited resources.

Still another asset is the experiment station IRAT at Bambey with its outlying stations in the major crop producing areas. The agricultural engineering division has developed suitable animal-drawn plows, cultivators, and seeders, for example. These are produced in a local factory, and are accepted by the farmers as an improvement over their own hand tools. The results of the research is being demonstrated on a community basis in many parts of the country.

The farmers have shown that they too can obtain high yields if the recommended practices are followed. The spread of these practices needs to be hastened, and it appears this is being done. One outlet source in the far eastern section reportedly sold 500 new cultivators and plows this spring.

SOME APPARENT GRAIN PRODUCTION PROBLEMS

- The cut and burn system of farming results in fields overrun with bushes sprouting from old tree stumps. These reduce the water available for cultivated crops and interfere with land preparation and weed control.

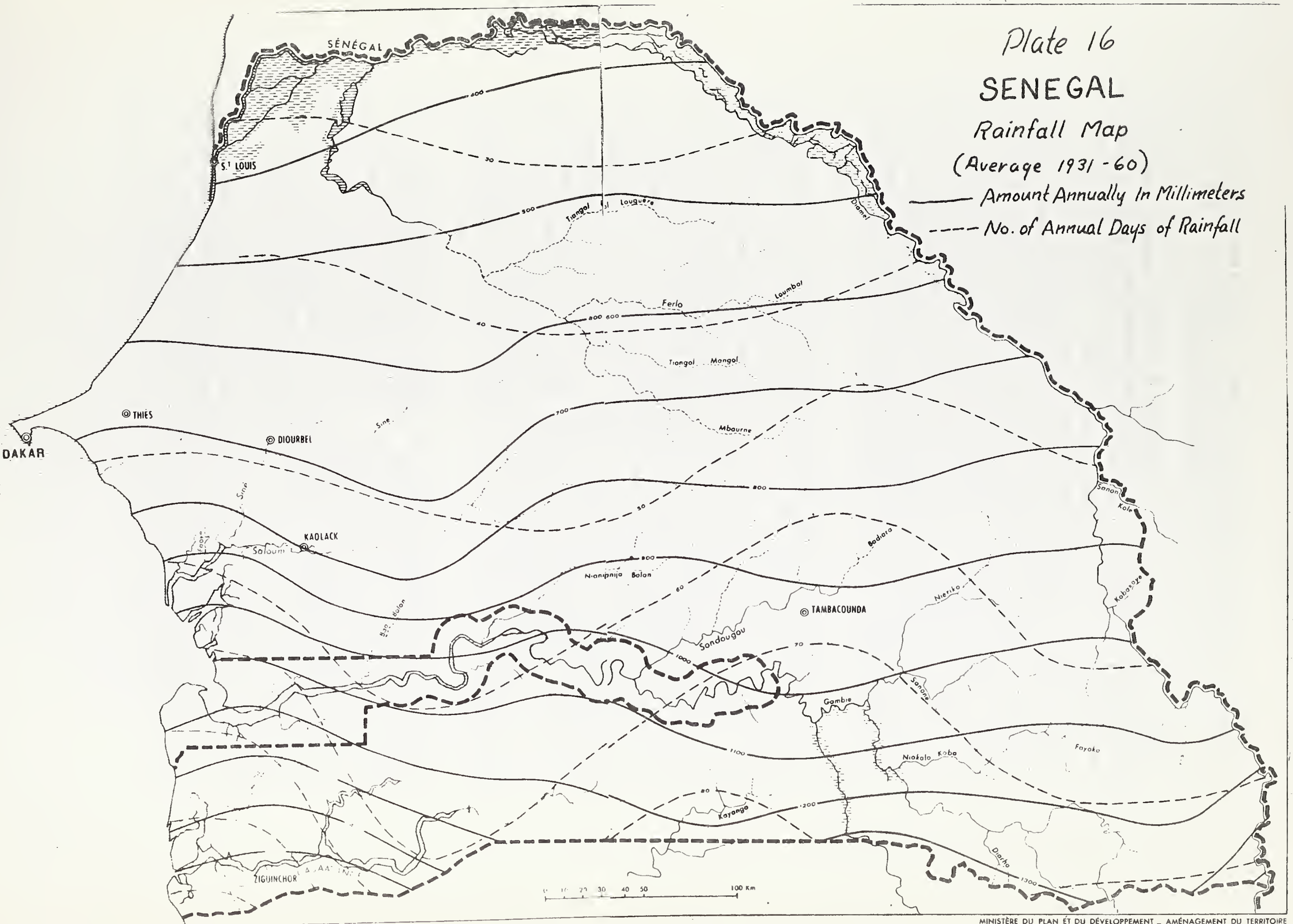
- The tremendous weed problem, mostly grasses, may get out of control at the planting season when there is

Plate 16

SENEGAL

Rainfall Map

(Average 1931 - 60)



always a shortage of farm labor. Suitable cultivating equipment other than hand tools is just getting started, but expanding rapidly.

- There is a lack of well-trained draft animals with sufficient strength to pull the simplest small plow. In many fields it is necessary for someone to lead the animal and, in some cases, pull. The animals are usually in poor flesh and almost never fed any grain, even during the peak of the work season. The roughage is low quality compared with most standards--usually coarse millet and sorghum fodder with an occasional feeding of peanut hay. The one exception the team found was at the experimental station (IRAT) at Bambey. There, and also at their demonstration farms, the animals were in fair to good flesh and received some ground sorghum grain and a fair amount of peanut hay. Their oxen used for draft were well-trained and in good flesh.

- The soils are mostly sandy, low in natural fertility, except along river beds that overflow. The silt content is extremely low and the clay content (mostly the kaolinitic type) may vary from 4 to 20 percent. The soils are usually acid, with a pH of 5.8 or less. The organic matter, as in all tropical soils, is low; in a few years of farming, soils are almost free of easily-decomposed organic matter. There is little fertilizer imported except ammonia, which is used by a local plant to produce about 55,000 tons of fertilizer a year. Some 25,000 tons of this is exported, however, leaving about 30,000 tons for local use. Fertilizer officials estimate that 12,000 tons of this is used on peanuts; 13,000 on sorghum, millet and corn; 2,000 on cotton; and 3,000 on rice. This is an average of 10 to 11 kilos per hectare on cereals and peanuts.

  The fertilizers are sold as complete mixtures and fabricated in 10 different grades, with about 45 percent in the 14-7-7 grade. The estimated cost of production is $100 per ton. The fertilizer is sold to the farmer at about $50 per ton. If it were not for the lack of hard currency, the fertilizer could probably be purchased on the world market at about the same price it now costs the fertilizer plant to produce the material locally. It is apparent the people of Senegal fail to recognize that the purchase of sufficient plant food will actually generate the flow of more currency into the country than out of it through increased exports or the reduction of food or feed grain imports.

One way to reduce government expenditures for fertilizer is to increase the plant food in each ton and thus reduce the transportation costs, which amount to approximately $24 per ton. By shifting to a more concentrated fertilizer, it would be possible to save over $150,000 annually through the reduction of transportation costs.

- Farm-to-market roads are very limited in relation to need. The high cost of transportation limits the use of some of the more productive soils and greatest rainfall. Transportation costs quoted by commercial carriers were 12 CFA/ton/km. on hard surface roads; 20 CFA/ton/km. on improved but not hard surface roads; 28 CFA/ton/km. on unimproved trails; and 38 CFA/ton/km. on bad trails. This is equal to 8 cents per ton mile on hard surface road and 25 cents per ton mile on bad roads, or more than four times the cost in the United States.

- In many fields there are numerous ant hills that obstruct row production.

- Except for peanuts, the farmer has had little assurance of a reasonable market for his crops at the close of the harvest season. This, plus the fact that the average yields of peanuts exceed the average yields of feed grains, offers little incentive for farmers to produce grain crops above the local needs. In fact, it encourages the planting of peanuts. The farmer cannot afford to take many or great risks, as the grain crop is his main food crop. The farmer usually plants enough grain to meet his own needs; in some villages he is also required to store enough for the second year in case of unusually bad loss or crop disaster. When nature is kind to the farmer he may offer some for sale, but he depends on the peanut crop and now cotton and rice to provide him with needed cash or barter for his other needs. This reduces the incentives to produce grain over peanuts. Recently steps have been taken to partially correct this situation. It appears the support price of peanuts is high in relation to grain and will discourage any great increase in grain production unless yields are greatly increased.

- Except for peanut producers in cooperatives, farm credit has not been available to the farmers at favorable terms. Even then credit is available only for a limited number of items. This too has been partially corrected in some areas.

A SUGGESTED PROCEDURE FOR ATTACKING THE PROBLEMS

Since it is not possible to make, at one time, all the changes in cereal production that appear feasible and desirable to reduce the cost of production per unit of output, a series of steps is suggested.

1. The use of animal power and the new cultivators and seeders should be greatly expanded. To make better use of these tools, the farmers should be encouraged to provide better feed, including ground grain, for his draft animal, at least during the heavy work season.

2. Continued efforts should be made to improve the seeders for sorghum and millet. The peanut seeder appears to be satisfactory, but a better distribution of the sorghum and millet seed could probably be accomplished with a thinner plate with holes that hold less seed and proper plate spacings so the rate of seeding can be adjusted to soil and moisture conditions. There should be a separate set of plates for the millet. This is to eliminate the thinning operation now recommended but often neglected or delayed until the root system of the remaining plants are injured in the thinning operation.

3. The cultivated land should be cleared of woody plants as soon as possible to make better use of animal-drawn equipment. At present it takes 5 to 10 years to completely kill the roots of cleared trees and prevent resprouting. A herbicide suitable for shortening the time needed for complete reclamation (such as 2-4-5T) should be tried to determine cost-benefit ratios. This work should be carried out in cooperation with IRAT at Bambey. The weed work at present is under the leadership of Mr. P. Jan, whose home office is located in France. These trials should be carried out on small plots in fields of cooperating farmers, under widely varying rainfall and soil conditions and plant species. Also, various application rates should be tried on various plant species at different times of the year.

4. The ants in the mounds should be eradicated with an appropriate insecticide and the ant hills leveled to make the fields easier to prepare, plant, and cultivate.

5. Both grassy and broadleaf weeds must be brought under control to take advantage of the improved

This raw material could be urea, 46 percent super phosphate, and either muriate or sulfate of potash. One other mixed fertilizer might be considered, and that would be diammonum phosphate or an 18-46-0.

IMPLEMENTATION

The agronomist assigned to AID/Dakar should work to accelerate the use of animal-drawn tools and to introduce other suggested practices that appear desirable. At the start of the assignment, the agronomist should make it known to both SODEVA and IRAT that he has no intention of duplicating their work or working independently, but that he is to cooperatively assist them in their efforts to develop and improve the design of their equipment and to hasten its adoption.

To do this, a contract should be made with the Agricultural Engineering Division of IRAT at Bambey to place one man full-time (for about 6 months) on improvement and testing of the animal-drawn seeder. This seeder should be made to place two or three sorghum seeds in a hill, the hills spaced about a meter apart. This is to obtain a uniform planting and eliminate the need for thinning the plants after they become established. Millet should be planted in a similar fashion, but it will be necessary to have a separate plate for planting this small seed. It may be necessary to develop a set of sieves to size the seed for more accurate planting. This may take two different sized screens for each crop. The larger opening sieve should remove the extra large seed and the smaller one should let the smaller size seed through. The part retained on the smaller screens would be the one used for planting.

Since many of the people are now using flint-type field corn as a food and are fond of it as roasting ears, the team believes the introduction of sweet corn would be regarded as a worthy contribution to their food supply. If the sweet corn receives wide acceptance and becomes popular, it is possible that the sweet corn could be dried and stored for use during the dry season. It would be necessary to teach the people how to process the sweet corn if the corn is in demand as an important food in their diet.

Cooperative field tests should be started to determine the value of herbicides in hastening the kill of woody plants such as tree stumps. We would suggest trials using 2-4-D and 2-4-5T and a 50-50 mixture of the two. If the 2-4-D provides satisfactory control, this would be the one to use since the cost of the material would be less. Both water and oil should be used as the vehicle, or carrier. For the oil treatment, use a mixture containing 16 pounds of actual 2-4-5T in 100 gallons of oil. Many of the concentrated forms contain about 4 pounds of actual material in a gallon. If a mixture of 2-4-5T and 2-4-D are used, the directions on the container should be followed. Notes should be made as to cost, labor saved in cutting regrowth, and effect on the crop, including

the difference in time required for the old stump to decompose to where it no longer interfers with land preparation and cultivation.

We also recommend field trials on the use of preemergent herbicides to control the grassy weeds that so often get difficult to manage during the planting season. This could lead to expanded sorghum and millet production and reduced production costs.

A spray of 1 to 2 kilos of actual 2-chloro-4, 6 bis (isopropylamino)-s-triazine (Propazine) should be applied immediately after planting. Perhaps the 1 kilo/hectare would be the best rate to use first. Most of the soils are sandy and have a low exchange capacity. This rate will not control all the weeds for the entire season, but it should hold back most of the grass for the first 30 to 40 days, or until the busiest part of the work season is over.

Unless a better method of weed control is found or practiced, there is some question whether it is advisable to encourage the use of commercial fertilizers. High nitrogen fertilizers such as urea applied as a top-dressing on the surface will further enhance weed growth, making weeds more competitive with the crop for the limited moisture than if fertilizer had not been applied.

In the fields that are prepared with the turning plow, there is less likelihood of serious weed growth. In this case, nitrogen could be applied either to the surface and plowed under or as a top-dressing. As a top-dressing, care should be used not to let the fertilizer fall in the whorl or on the tops of the plant.

Since there is an expansion of animal-drawn equipment and the present condition of the animals is far less than desired to perform the field work, it would appear that feeding demonstrations should be initiated to show the value of providing a more nutritious feed to the work animals, at least just prior to and during the peak of the work season. This might be started with a few cooperators in the villages. Details of this operation would need to be developed and worked out with SODEVA or the extension service, including arrangements for feed and a schedule for animal care according to available feed sources. No doubt some ground feed such as corn and sorghum would be essential to increase the energy level. Peanut hay might be used to provide the protein. A record of the production work could be checked against that of other animals fed in the usual manner, as well as records of changes in in animal conditions and health.

Before any extensive fertility program is started, we would recommend that the agronomist contact Dr. J.W. Fitts, Director of International Soil Testing at 101 Williams Hall, North Carolina State University, Raleigh, North Carolina 27607, to obtain directions on submitting samples for analysis and evaluation. Sampling procedures should follow recommendations by the laboratory. The laboratory will also provide instructions on how to prepare soil from foreign countries for shipment into the United States. It

should be remembered there are many small insects and weed seeds, such as striga or witch weed, that must not be permitted to escape on U.S. lands.

After the available phosphate and potassium status has been determined, a more logical fertilizer treatment can be formulated. Until this has been done and the mold board plow is used in the preparation of the seedbed, it would appear desirable to try the introduction of urea nitrogen for the production of sorghum and corn. This would most likely produce greatest returns on the soils near Dakar, where the pressure on the land is greatest and agriculture has become more stabilized on a continuing basis.

As soon as new and improved varieties are released, it would appear desirable to assist in developing a seed multiplication and distribution system in regions where the varieties are adapted. No doubt there are better varieties of adapted grains already available which are not being widely used. It would have taken considerable time to make this determination and there were other production factors that appeared to need prior attention.

After the agronomist has had an opportunity to observe the grain crops through a growing season, he will need to reevaluate the conditions and select the improved practices which will not only reduce the cost per unit of production but will also be quickly adopted. The team believes the items listed are ones that look the most promising at this time. Depending on the rapidity of adoption, it is believed the cost per unit can be reduced at least 50 percent and yield more than doubled. If this should take place, there will be a greater interest in grains and a good possibility that feeding grain to livestock will become attractive and profitable.

SUGGESTED BUDGET

The following estimates are based on the premise that the agronomist would spend a third of his time in Mauritania and the rest in Senegal. The estimated cost of the operation in Mauritania has been listed in a separate report for that country.

The contract included in the estimated costs would be for services of one man who could work under the supervision of the Agricultural Engineering Department for about 6 months to improve the present animal-drawn planter or seeder. His main objective would be to make the tool properly space sorghum and millet seed in rows at a ratio that would not require thinning. This equipment should be field tested and made so different rates of seeding could be applied for both millet and sorghum.

It is anticipated that most of the travel would be local and might be handled through rented vehicles, at least for the first 6 months. Most of the travel for the first 6 months would be local, probably no further away than Tambaconda.

Estimated costs for first 18 months

	First 6 months	Last 12 months	
U.S. agronomist, 2/3 time	10,000	20,000	
Contract with IRAT, 6 mos.	4,000	4,000	
Travel within country	1,000	2,000	
Equipment and supplies	1,000	2,000	
Secretarial service, 2/3 time	1,000	2,000	
Office space, 2/3 time	2,400	4,800	
Training aids	500	1,500	
Publicity	300	1,500	
Records and reports duplication	500	1,000	
Travel to other tropical research stations outside Senegal	---	1,000	
	20,700	39,800	
Overhead (50 percent)	10,350	19,900	
	31,050	59,700	
Estimated cost first 18 mos.			90,750
Estimated cost first 18 mos., Mauritania			69,900
Total cost of agronomist, first 18 mos.			160,650

Equipment and supplies would include sprayers, herbicides, feed (ground grain), and perhaps peanut hay to test improved feeds for work animals.

The recruitment expenses were charged to the Mauritania portion of the budget. No doubt it will be necessary for more correspondence with Mauritania officials since the agronomist will be located in Dakar.

Training aids are needed to help the cooperators understand what needs to be done and reasons for carrying out the work as directed.

Publicity is included to make sure government officials and news media have an opportunity to see improvements accomplished by shifting to more efficient production methods.

Reports and records should be made attractive and useful to the reader. Appropriate illustrations should be used to increase interest and readability.

The agronomist should be encouraged to attend conferences in nearby countries if topics discussed have a bearing on the work in Senegal and Mauritania. There should be provisions for selected counterparts to also attend.

Plate 4

Regional

Sanitation Program

A. General Storage Considerations

1. **INSPECTION.** An inspection program should be initiated to maintain a continuous check on the condition of grain being held in storage and on the condition of storage facilities and areas, regardless of the type of storage facility.

a. Storage Sites. Areas around the outside of storage facilities should be inspected routinely to detect:

(1) Accumulations of spilled grain which attract rodents and provide a breeding site for insects.

(2) Tall weeds, grass and accumulations of junk or other debris which provide cover for rodents.

(3) Evidence of rodent activity - burrows, runs, etc.

b. Storage Structures. Warehouses, unmechanized bins or silos, and mechanized silos should be routinely inspected for:

(1) Openings at or near ground level that would allow rodents to enter.

(2) Openings in upper areas that would allow birds to enter.

(3) Holes in roofs or other openings that would allow the grain to become wet by rain.

c. Condition of the Stored Grain. All grain when it is placed in storage should be inspected for moisture content, and the presence of insects, rodents and molds. It is particularly important that grain being carried over from one crop year to another be closely checked for the presence of insects, rodents and mold development.

To reduce the risk of serious losses due to insects and molds, the following general plan of actions should be followed:

(1) Know the moisture content of the grain. Do not attempt to store grain containing more than 13% moisture. Dry it to 12 to 12.5% moisture before placing the grain in storage. High moisture grain will spoil rapidly under West African conditions. Moisture migrates in stored grain under certain conditions. Initial low moisture, while good insurance, does not preclude localized high moisture due to migration.

(2) If it is possible to check the temperature of the grain in storage this should be done at least monthly, preferably more frequently. If localized temperature increases are noted in a quantity of grain, the cause should be determined. Sharp localized temperature increases will occur under two conditions. First, if large numbers of insects are present, their activity will result in a localized temperature increase. The temperature will not exceed 105-110° F. This condition can be corrected by fumigation.

Secondly, the temperature increase may be the result of mold growth in pockets of damp (high moisture) grain. This can occur due to moisture migration. Temperatures as high as 130° F. or higher can be experienced. Preferably this grain should be uniformly dried to 12.0% moisture content for safe long term storage.

(3) To detect the presence of insects in grain, a representative sample of the grain should be obtained. Grain samples should be sifted using a screen with openings approximately 0.083 inches in diameter (screen with 10 wires per inch). Any number of live weevils, borers (rice weevil, granary weevil, lesser grain borer) or Angoumois grain moths in the sample are indicative of "hidden infestation" (insects developing within the kernels of grain) and the grain should be fumigated. Grain that contains more than two other grain insects per kilo should be fumigated also.

(4) The presence of mold in grain is sometimes not easily detected by simple means. Obvious visual evidence of mold is an indication that moistures exceed that for safe storage and the grain should be dried or disposed of as soon as possible. Other indications of mold damage are discolored germs and/or reduced germination and there are some reasonably simple techniques for making these determinations.

2. HOUSEKEEPING. Probably the most important means of maintaining grain free of insect infestation and preventing losses due to rodents is through proper housekeeping of storage sites and structures.

a. Maintenance of the storage site.

(1) Spillage of grain in the area of the storage site should be prevented and if it occurs, should be cleaned up immediately. Not only does spillage serve as an attractant to rodents, it also attracts grain insects and provides a breeding site for them.

(2) Accumulation of chaff, hulls, and other materials cleaned from grain at the storage site should also be prevented. This material often contains enough grains to serve as a breeding site for insects.

(3) Tall weeds, grass and accumulations of equipment and debris provide cover for rodent activity. Weeds should be eliminated from the storage site by frequent cutting or the use of herbicides. Grass maintained around the storage structures, should be cut frequently.

b. Maintenance of the storage structure.

(1) A regular schedule should be established for cleaning areas of the storage structure - warehouse, silo, etc.

(2) Spillage and accumulation of grain and grain cleanings in warehouses and in other storage structures should be prevented, because they will attract and provide food for insects, rodents and birds.

(3) Housekeeping instructions for specific types of structures are given later in this section.

3. FUMIGATION

a. General Considerations

(1) Grain should be fumigated on the basis of need as determined by inspection of the grain.

(2) In areas where infestation of grain occurs in the field, fumigation within two weeks after initially storing the grain is recommended.

(3) It should be pointed out that an effective fumigation is dependent on confining a toxic concentration of gas within the grain mass for a sufficient period of time to kill all insects present in the grain. Too low a dosage, a container (bin or gas tight tarpaulin) which will not contain the gas or too short an exposure period are some factors that can result in an ineffective fumigation. Once the gas has been dissipated or escaped from the grain, the grain is again subject to infestation from outside sources.

(4) Routine fumigation of grain as an insurance measure is a reasonable practice but should not be relied on at the expense of an inspection program.

b. Materials and Dosages

(1) Phostoxin has proven an excellent grain fumigant and its use in the West African grain storage program is recommended.

This material:

(a) Has excellent penetrating and killing characteristics.

(b) Is easily applied to grain as it is moved in mechanized silo storage, can be used effectively in fumigating static stored bulk grain and sacked grain under gas tight tarpaulins or in gas tight enclosures.

(c) Is generally less hazardous to use than other fumigants, both from the standpoint of personnel safely and maintenance of grain quality. Unlike some other grain fumigants, Phostoxin does not adversely affect germination of seeds.

(2) The amount of fumigant required for an effective fumigation depends, as previously indicated, on several factors. Recommended Phostoxin dosage rates for various types of storage structures are indicated in the following table:

Type of Storage	Grain Temperature	Dosage/Metric Ton	Time
WAREHOUSE			
Bagged grain under gas-tight tarpaulin and bulk grain stored in piles or within bag bulkheads under gas-tight tarpaulins	54-59° F.	6 Tablets	4 Days
	60-68° F.	4 Tablets	4 Days
	69° F+.	3 Tablets	4 Days
NON-MECHANIZED SILOS			
Steel Bins	54-59° F.	5 Tablets	4 Days
	60-68° F.	3 Tablets	4 Days
	69° F+.	2 Tablets	4 Days
Cement Block Bins	54-59° F.	7 Tablets	4 Days
	60-68° F.	6 Tablets	4 Days
	69° F+.	5 Tablets	4 Days
MECHANIZED SILOS			
Concrete elevators or steel tanks with turning facilities	54-59° F.	5 Tablets	4 Days
	60-68° F.	3 Tablets	4 Days
	69° F+.	2 Tablets	4 Days
Concrete elevators or steel tanks with turning facilities	54-59° F.	25 Pellets	4 Days
	60-68° F.	15 Pellets	4 Days
	69° F+.	10 Pellets	4 Days

(3) The Manufacturer or his representative should be requested to supply literature and/or technical assistance regarding the application of Phostoxin. Properly controlled use of any fumigant is essential to attain satisfactory results.

Potential supplies of Phostoxin in West Africa include:

Chimie-Afrique
B.P. 1896
Abidjan, Ivory Coast

Chimie-Afrique
B.P. 1604
11, Avenue Jean Jaures
Dakar, Senegal

Union Trading Co., Ltd.
Chemicals Department
P.O.B. 298
Accra, Ghana

Union Trading Co., Ltd.
Chemicals and Crop Protection Department
P.O.B. 8
Ibadan, Nigeria

Union Trading Co., Ltd.
Chemicals Department
P.O.B. 572
Lagos, Nigeria

B. Specific Instructions for Various Types of Storage.

1. Warehouse Storage - Bagged Grain

a. Inspection of Grain

(1) Grain stored in sacks should be checked for the presence of insects, rodents and/or deterioration due to molds by visual examination of the exterior of the stack.

(2) Probe samples of grain should be taken at random from bags over the surface of the stack and examined for the presence of insects and/or mold. If live insects are found, the grain should be fumigated.

(a) Grain should be inspected at least monthly.

(b) Moisture content of the grain should be determined.

(c) Samples of grain from the interior of the stack cannot be taken practically, however, temperature cables (thermocouples) are available that can be placed within the stack as grain is stored. Temperature readings obtained in this manner can indicate heating within the stack due to insects and/or molds.

b. Storage Methods

(1) It is imperative that bagged grain be stacked off the floor on pallets in an orderly manner and that space be provided along walls, between stacks and above the stack so that gas-tight tarpaulins may be used to fumigate the grain if necessary. Stacks should not exceed 6 meters in width or height with length variable.

(2) Maintenance of the warehouse free of accumulations of spilled grain, cleanings from the grain and other debris is mandatory to prevent stored grains from becoming infested. Clean up should be accomplished daily.

(3) Reuse of sacks is an important source of cross infestation of stored grain. Bags should be fumigated before they are reused. This can be accomplished by placing the bags under a gas-tight tarpaulin similar to fumigation of stacks of bagged grain. Phostoxin at the rate of 45 Tablets per 1000 cubic feet of space can be used.

(4) Residual spraying of an insecticide can be used on floors and walls of warehouse especially along cracks and crevices to prevent build-up of insects in these areas and to prevent their migration to stored grain. Malathion is a suitable material for this purpose and should be applied according to the manufacturer's instructions.

c. Fumigation.

(1) Stacks of bagged grain should be fumigated using gas-tight tarpaulins. Polyethylene sheeting is a satisfactory material for this purpose. Heavier gauge (6 mil) polyethylene sheeting will allow the sheeting to be reused, however, lighter weight material will provide a satisfactory material for containing the gas.

To provide an effective fumigation, the gas-tight tarpaulin should be sealed to the warehouse floor so that the gas does not escape. Sand used to weight the edges of the tarpualin will provide a suitable seal if the floor is smooth.

(2) Phostoxin is an effective material for fumigation of bagged grain and should be applied in the dosages indicated earlier in this section.

2. Bulk-stored grain in unmechanized silos (including bulk stored grain in warehouses).

a. Inspection of grain

(1) Samples of grain from bulk stored grain should be obtained by use of grain "probes" or "triers". Samples can be taken from depths up to 18 feet (6 meters) with this type of equipment. Samples should be taken from various parts of the bin to obtain a representative sample.

(a) Grain should be examined for the presence of insects and/or mold. If insects are found, the grain should be fumigated.

(b) Moisture content of the grain should be determined. If moistures are above 13.5% or if molds are detected, the grain should be dried.

(c) Samples should be taken at monthly intervals.

(2) Temperature of the grain can be determined by various methods and can be used as a means of detecting heating caused by insects and/or molds.

(a) Portable temperature sensing cables (thermocouples) can be probed into the grain and temperature readings taken. Individual cables can be placed in the grain and left in place while the grain is in storage or one cable can be moved from one sampling point to another. Readings are taken by means of a portable battery operated potentiometer.

(b) Grain temperatures may also be determined by probing ordinary thermometers into the grain.

(c) Steel rods or wooden poles provide a crude means of determining whether grain is heating. To detect hot spots, the rods are pulled from the grain and felt with the hand. Warm areas on the rod indicate heating in the grain mass.

(d) If hot spots are detected, the cause should be determined by probe sampling and appropriate measures (fumigation or drying) taken to correct the situation.

b. Storage methods.

(1) Prior to placing grain in any silo (bin):

(a) The bin should be thoroughly cleaned to remove any old grain residues.

(b) The interior and exterior of the bin should be sprayed with an insecticide (malathion) about two weeks before grain is placed in the bin.

(2) The surface of the grain in the bin should be leveled in event fumigation is required.

c. Fumigation.

(1) Phostoxin tablets may be added to grain as it is placed in storage or they may be "probed" into the grain by means of a one-inch inside diameter pipe or conduit. Tablets should be probed into the grain mass to uniformly distribute them throughout the grain.

(2) If there is a relatively large space above the grain surface, a polythylene or other gas-tight sheet should be placed over the surface after the tablets have been applied.

(3) In situations where bulk grain is stored within bulk-heads formed of bagged grain, procedures recommended for stacks of bag stored grain are applicable.

(4) Dosage recommendations are given in the fumigation section, "A. General Storage Considerations".

3. Mechanized Silo Storage.

a. Inspection of Grain

(1) Samples from grain in mechanized silos usually have to be taken as the grain is moved from one silo to another.

(a) This can be done by having a worker obtain a series of small samples of grain from the conveyor discharge periodically as the grain is "turned".

(b) Samples should be examined for presence of insects and/or molds. If insects are found, the grain should be fumigated.

(c) Moisture content of the grain should be determined. If it exceeds 13.5% or has visible evidence of mold it should be dried.

(2) If temperature monitoring equipment is available in the silo bins, records should be made of the grain temperatures at least monthly, more frequent preferably. If localized temperature increases are noted in a bin of grain, the cause should be determined by turning the grain and sampling.

(a) If the quantity of grain heating is not large and the cause is damp grain, merely turning the grain may dissipate the heat and damp grain.

(b) If heating is caused by insects or if the quantity of damp grain is large, fumigation or drying will be necessary.

b. Storage Methods

(1) Mechanized silo bins should be cleaned and sprayed with insecticide (Malathion) as recommended for unmechanized silos.

(2) Accumulations of spilled grain, dust, grain cleanings, etc. should be cleaned up daily.

(3) Equipment used to handle grain - conveyors, elevators, etc. - should be cleaned out weekly and sprayed with an insecticide (Malathion).

(4) Service areas in mechanized silos (if they are present) such as tunnels beneath bins, enclosed areas above bins, etc. may be sprayed with an insecticide (Malathion) to prevent build-up of insects.

c. Fumigation.

(1) The only practical way of applying Phostoxin to grain in mechanized silos is to add the fumigant tablets (or pellets) to the grain stream as it flows into the silo bin. This can be done manually or automatic dispensing equipment can be used.

(2) Prescribed dosages are given in the Fumigation section of "General Storage Considerations".

C. Rodent Control.

1. The most effective way of reducing rodent populations is to eliminate harborage sites and other forms of cover and to limit their food supply.

a. Methods for limiting harborage sites and cover are outlined in the "General Storage Considerations" section.

b. Limiting the food supply is accomplished by keeping spillage of grain residues to a minimum in and around the storage facility and by providing a rodent proof facility.

2. Rodent-proofing of storage facilities, in part, can be accomplished by:

a. Placing ¼ inch mesh screen over windows or other openings at or near ground level.

b. Sealing holes or small openings into storage facilities with metal.

c. Use of metal flashing around the base of storage facilities to prevent rodents from climbing rough surfaces.

d. Making doors to warehouses tight-fitting.

e. Any other means to prevent rodents from entering the storage facility.

3. Chemical control of rodents involves the use of toxic materials (rodenticides) to poison the rodents and should be accomplished by trained personnel.

a. Certain rodenticides will kill with one feeding and are hazardous to use near stored grain.

b. A group of materials called "anticoagulants" are used for rodent control in baiting programs.

(1) Anticoagulants are generally mixed with a cereal of some type (corn meal works well) and placed near storage facilities in bait stations.

(2) Rodents seek cover in the bait stations, feed repeatedly on the bait and die as a result of internal hemorrhage.

c. A regular program of baiting with anticoagulant rodenticides should be established at each storage site.

4. Various types of traps are available for rodent control. They should be employed in an integrated program of rodent proofing, housekeeping and baiting to maintain populations at a low level.